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BURNS

Collective Review

CHARLES C. LUND, M.D., F.A.C.S., ROSS W. GREEN, M.D., F. H. LASKEY TAYLOR, Ph.D., and STANLEY M. LEVENSON, M.D., Boston, Massachusetts

IN comparison to the great economic importance of burns in all parts of the world in times of peace as shown, for instance, by the more than 5,000 deaths per year in the United States alone, scientific studies concerned with them have always been relatively small in number and relatively poorly supported. The present war with its lavish use of gasoline and oil as motive power and the use of bombing as a weapon has stimulated the Allies to mobilize national resources and many scientists for comprehensive studies of the consequences of fire. This report will be concerned, for the most part, with the developments in Great Britain, the British Dominions, and the United States. Nothing is known to the authors concerning any studies on burns in Germany and Japan or in their satellite or conquered countries during the 5 years since Belgium has been cut off from the Allied World.

DEFINITIONS

A. Depth of burn.

For many years the universal custom in the United States and Canada and the preponderant custom in Great Britain has been to classify burns according to their depth into three categories as follows: first degree, simple erythema; second degree, partial destruction of the skin, but without destruction of all the deep epithelial cells; and third degree, destruction of the full thickness of the skin. In the French literature prior to the war, the Dupuytren classification was used by most authors. In this classification, the definition of first degree burns is the same. Dupuytren's second and third degree burns correspond to superficial and deeper second degree burns as just classified, and Dupuytren's fourth, fifth, and sixth degree burns correspond to the third degree just defined. Converse and Robb-Smith have recently classified the depth of burns in a manner extremely useful to any one who is evaluating the results of treatment. This classification divides the burns in such a way that the deep second degree burns and mixed second and third degree burns, both of which types heal slowly under any treatment, are no longer tabulated with the more superficial second degree burns which heal easily with almost any form of treatment. They use a name rather than a number to describe a burn. Their names, descriptions, and prognoses are compared in Table I with commonly accepted meanings of the degrees of the Dupuytren and American classifications. This excellent classification has been suggested so recently that it has not been used by other authors as yet. However, there has been a widespread use by American authors of the subdivision of the "second degree burn" into superficial and deep second degree burns. Admittedly, the newly proposed class of "mixed burns" will contain only a small proportion of the cases in any series, but these burns are a distinct and important entity. The authors of the present review will use this new classification in order to avoid any confusion that may possibly arise by the use of either older classification.

From the Burn Assignment of the Surgical Services and the Thorndike Memorial Laboratory and the Second and Fourth Medical Services (Harvard) of the Boston City Hospital and the Departments of Surgery and Medicine of the Harvard Medical School. The work described in this paper was done under a contract, recommended by the Committee on Medical Research between the Office of Scientific Research and Development and Harvard University.

This review comprises the major part of a review prepared for the Belgian-American Foundation of New York and the Foundation Francqui of Brussels for distribution in French translation to all the doctors of Belgium. This is one of a series of reviews named "Actualites Medico-Chirurgicales."

TABLE I—CLASSIFICATION OF DEPTH BURNS

Dupuytren	American	Converse and Robb-Smith		
Degree	Degree	Name of Burn	Description	Prognosis
1st	1st	Epidermal	Erythema followed by desquamation	Heal well
2nd	2nd	Dermal	Blistering and superficial destruction of the derma	Heal well
3rd	2nd	Deep dermal	Destruction to deep layers of derma	Heal slowly
Mixed 3rd & 4th	Mixed 2nd & 3rd	Mixed burns	Small areas of deep dermal alternate with small areas of deep burns	Heal slowly
4th, 5th & 6th	3rd	Deep	Destruction of whole thickness of the skin into or beyond the fat	Heal with difficulty. Produce contractions unless grafted

At the occurrence of the burn and for several weeks thereafter it is frequently not possible to estimate correctly the depth of the injury. Many small blebs, some broken and some intact, with an external ooze of plasma, visible pink corium, and minimal subcutaneous edema indicate a dermal burn. A dry, dead white, brown, or charred appearance with beginning subcutaneous edema indicates a deep burn. The appearance of other burns is intermediate between those described and these burns cannot be classified until epithelization or granulation have become evident. Dingwall and Patey and Scarff have attempted to solve this difficult problem. The former has observed his cases with ultraviolet light and a filter after intravenous sodium fluorescein injections, and the latter have studied serial microscopic sections of burns and also the naked eye appearance after the application of Van Gieson's stain. Both these methods are promising but neither has been evaluated, as yet, by other workers.

Until Dingwall's or Patey and Scarff's suggestions have been found to be widely applicable, burns should not be classified until healing or epithelization is well under way. Most of the recent authors have been cognizant of this, but there are a few recent articles which indicate that the authors think they can estimate the depth of a burn when the burn is first seen. This is shown, for instance, by a statement that a given form of treatment has "prevented the burn becoming a deep burn."

B. Area of burn.

Although the proportionate area of skin burned has long been recognized as useful as a guide to the prognosis of burns, it has now become of even greater importance as a guide to treatment. One of the first needs of a patient with a serious burn is adequate plasma therapy. After a close estimate of the area of the burn and of its proportion to the total area of skin has been made, a formula may be used to estimate the approximate amount of plasma needed during the first day of treatment. Such a formula will be presented later.

Long prior to its use for this purpose, Weidenfeld and Berkow (16) made studies directed toward simplifying the recording of and comparison of burns. Both studied by actual measurement the surface areas of the parts and of the whole surface of many individuals of all ages. As a result of this work "Berkow's table" is constantly in use in this country and Great Britain for the study of burns, and all recent important studies have used it. Both Weidenfeld and Berkow pointed out that the proportionate area of the parts of an individual vary widely between birth and adult life. Pack and Davis, Seeger, and Wallace also pointed out this fact, but the majority of important publications that have stressed the use of Berkow's table have mentioned only his table for adults.

While in search of a suitable diagram and standards for the recording of burns in children, Lund and Browder found that Berkow's tables for adults and children, which have been perfectly satisfactory for work up to date, are oversimplified and contain certain errors that should, if possible, be avoided in the more exact studies that are now being made in many clinics. The results of their study are seen in Figures 1 and 2, which are reproduced from their article. It should be noticed particularly that the area of the face makes up a relatively large proportion of the total skin area of infants when compared to the findings in adults, and is counterbalanced by the small area of the infant's thighs and legs. Also, the proportion of skin of all other parts is essentially unchanged from one age to another. The area determined for the trunk is much smaller than the area assigned to it by Berkow.

PATHOLOGY

A. Local.

Burns either injure or kill cells. The cell membranes become abnormally permeable to

various substances. A very superficial burn will result in the injury of the most superficial cells but no cells will be killed. A deeper burn will result in the death of cells to a certain depth, and underlying these cells there will be injured but viable cells.

The response to the mildest burn or the response to a more severe burn at the point in depth where the burn is minimal is dilatation of the capillaries and the finer arterioles and venules with markedly increased blood flow through all of the three following a brief period of vasoconstriction.

In some mild first degree burns this is the only demonstrable result. In slightly more severe burns the capillary walls are injured and leak blood plasma into the tissues. At the same time other cell membranes leak and there is an abnormal exchange of cell constituents into the tissue spaces and of tissue fluid into the injured or dead cells. If the burn is deep enough, red cells in the capillaries may be damaged or even ruptured immediately.

Because of the leakage of plasma from the capillaries, the tissue spaces become distended with fluid. This fluid, if near the surface, forms in blisters under the epidermis at first and after rupture of the blisters continues to pour out for more or less lengthy periods of time. The fluid that represents capillary leakage at deeper levels finds its way slowly into the lymphatic system (83). A result of this is greatly increased lymph flow from the area. Both the lymph and the blister fluid coming from the burned area have long been known to be similar in composition to the plasma prior to the onset of infection (13, 134).

Pressman and his associates have recently restudied this problem and have found constant amounts of albumin and variable amounts of globulin in blister fluid. Glenn, Peterson, and Drinker, and Cope and Moore (45) have studied the flow, pressure, and composition of lymph after burns. The amounts of fluid that may be lost through, into, or under a burn are frequently large, as will be indicated later. It is also extremely important to remember that while the burned skin is permeable to plasma, it is also permeable in the other direction. Absorption of various substances will be considered in detail later.

At once, after a burn, repair processes start. When the damage is minimal, the repair consists of the return of normal tone to the blood vessels, the cessation of leakage, and the absorption of any fluid that is present in the tissue spaces. If cells have been killed, the dead cells are removed by lysis and phagocytosis. In case the burn is deep, this process takes place only at the border between the living and the dead cells and the dead cells are sloughed off in masses or sheets. The intercellular collagen resists digestion more than the cells and the collagen fibers keep the slough attached until they are finally digested at the point of demarcation between the living and the dead parts of the fibers. After the slough has separated, repair of the denuded surface takes place by a new growth of epithelial cells from islands of living cells, from the edges of the wound, or by successful skin grafts. If the derma is destroyed and healing occurs by ingrowth from the edge, the repair may be quite imperfect because a very thin sheet of epithelium covers the dense connective tissue that results from the final contraction of the granulation tissue. Besides being very thin, this scar epithelium is poorly nourished and poorly attached to its base. The repair process may be delayed as a result of local treatment, of infection, or of various deficiencies, such as those of iron, protein, or vitamins, but cannot be stimulated to heal except by creating optimal conditions so that there is no interference with cell division and cell maturation.

B. Pathology of red blood cells.

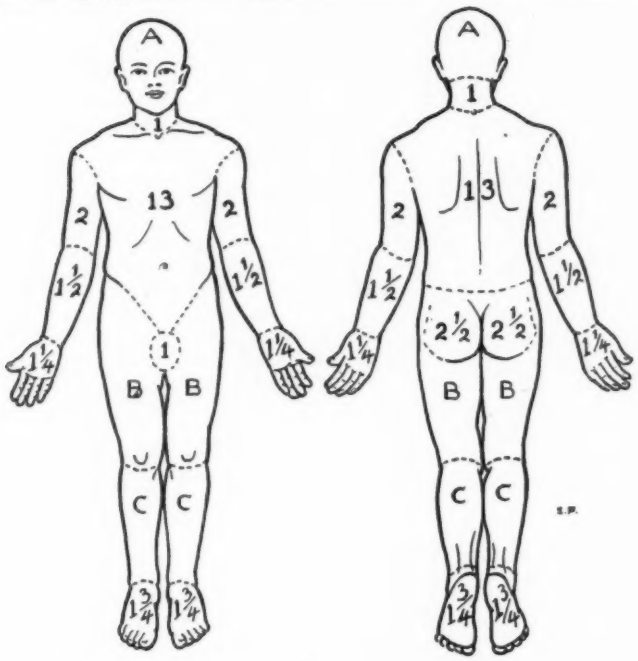
Inevitably, when sufficient heat penetrates to a depth in the tissue where there are capillaries, some red blood cells are injured. In vitro studies have shown that thermal injury of these cells occurs between 52 degrees and 65 degrees C. (167). Lysis frees the hemoglobin which is in the cells.

The occurrence of hemoglobinemia and hemoglobinuria after severe burns has long been known as an indication of a very serious burn. In general, the former is seen only in deep burns of 10 per cent or more of the body area, and the latter in such burns of 30 per cent area or more. Hemoglobinemia, when it occurs, is found to be most severe immediately after the burn and to decrease gradually during the first 24 to 72 hours. A long duration of hemoglobinemia in the plasma does not occur following burns. Hemoglobin does not appear in recognizable quantity in the urine unless it is present in large amounts in the plasma. Its duration in the urine depends on its duration in the plasma. The hemoglobin in the plasma and the urine has been shown to be for the most part oxyhemoglobin mixed with traces of methemoglobin (167). There is no evidence that burns ever release any form of myohemoglobin such as is found after "crush injuries."

BOSTON CITY HOSPITAL

Name ..... Age ..... Number .....

Burn Record. Ages 7½ to Adult. Date of Observation .....



RELATIVE PERCENTAGES OF AREAS AFFECTED BY GROWTH

Area	Age 10	15	Adult
A = ½ of Head	5½	4½	3½
B = ½ of One Thigh	4¼	4¼	4¾
C = ½ of One Leg	3	3¼	3½

% BURN BY AREAS

Probable 3rd° Burn	Head	Neck	Body	Up. Arm	Forearm	Hands	
	Genitals	Buttocks	Thighs	Legs	Feet		
Total Burn	Head	Neck	Body	Up. Arm	Forearm	Hands	
	Genitals	Buttocks	Thighs	Legs	Feet		

Sum of All Areas ..... Probably 3rd° ..... Total Burn .....

Fig. 1. *Over for Young Children*

Shen, Ham, and Fleming have confirmed the work of Spiegler and others who found that the blood of the burned patient with hemoglobinemia contained many abnormal red cells, such as fragmented cells and spherocytes with an increased osmotic fragility. No hemolysis or agglutinins are found (28). Hemoglobinemia and hemoglobinuria are discussed with the kidney.

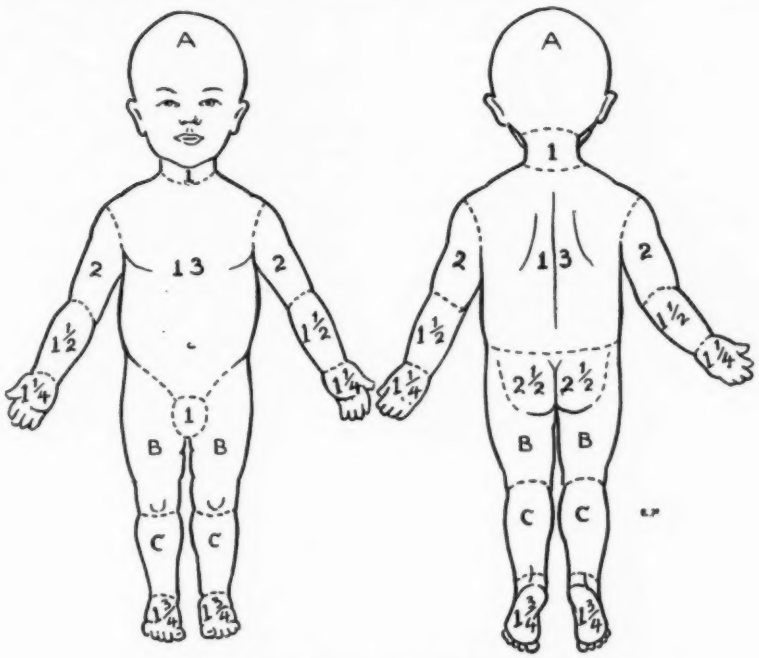
C. Blood platelets.

In very severe burns thrombocytopenia of severe degree occurs. MacDonald and her associates have shown that the platelet count may decrease to less than 50,000 within 16 hours after injury and the level may remain low for several days. This confirms older work of Salvioli and fails to confirm that of Welti and Locke.

BOSTON CITY HOSPITAL

Name ..... Age ..... Number .....

Burn Record. Ages—Birth—7½. Date of Observation .....



RELATIVE PERCENTAGES OF AREAS AFFECTED BY GROWTH

Area	Age 0	1	5
A = ½ of Head	9½	8½	6½
B = ½ of One Thigh	2¾	3¼	4
C = ½ of One Leg	2½	2½	2¾

% BURN BY AREAS

Probable 3rd° Burn { Head..... Neck..... Body..... Up. Arm..... Forearm..... Hands.....
Genitals..... Buttocks..... Thighs..... Legs..... Feet.....

Total Burn { Head..... Neck..... Body..... Up. Arm..... Forearm..... Hands.....
Genitals..... Buttocks..... Thighs..... Legs..... Feet.....

Sum of All Areas Probably 3rd°..... Total Burn.....

Fig. 2. *Over for Older Patients*

D. White blood cells.

Leucocytosis appearing immediately after the injury and continuing for variable lengths of time has long been known as a constant finding in nearly every burn of moderate or severe extent. The early leucocytosis is usually directly proportional to the severity of the burn. Later the leucocytosis varies directly with other evidences of infection such as fever. In a few cases of severe burns a leucopenia or relative leucopenia has been observed between the first and the sixth days. During the early leucocytosis or leucopenia the differential white blood count may show an increased proportion of nonfilamented leucocytes and other degenerative changes in the leucocytes, and the presence of myelocytes and the abscence of

eosinophils. Van Duyn has recently expressed the opinion that these degenerative changes are the result of a toxic injury to these cells, and that this proves that there is toxemia associated with burns that cannot be accounted for by injury, hemoconcentration, or infection. In his opinion this toxemia is caused by some substance absorbed from the burned area.

E. Renal function.

Impairment of renal function as evidenced by anuria, oliguria, and azotemia is a conspicuous feature in the early course of patients with severe burns. Albumin, hemoglobin, and casts are frequently found in the urine of these patients, while large numbers of white or red blood cells are rare. Reversible azotemia, associated with transient oliguria, occurs frequently even in burns of only moderate severity. This phenomenon is similar to that found following shock of any type and is presumably due to a decreased blood flow through the kidney during shock. The blood flow through the kidney may be decreased to one-twentieth of the normal at a time when the general blood flow is reduced only to one-half (111). This is true particularly in burn shock in which the vasoconstriction at any given peripheral blood pressure seems to be significantly greater than in other types of shock. Van Slyke has shown that a severe reduction in renal blood flow for many hours without reduction in the flow to the rest of the body may be followed by anuria and death of animals.

It has also been suggested that the kidney failure of burns is caused by the hemoglobin that is excreted in some cases (19). This is suggested by the histological changes in the kidney which are similar to the changes in patients with hemoglobinuria due to causes other than burns. The principal histological changes are the presence of pigmented (hemoglobin) casts, nonpigmented epithelial casts, and necrosis of the tubules. At autopsy on patients who survived more than 60 hours beginning regeneration of the tubular epithelium is also seen (76).

Although it is well established that intravascular hemolysis from a variety of causes is frequently followed by failure of kidney function, the mechanism of this action and the causative agent or agents in the hemolysed blood responsible for it have not been determined. It has been shown, however, that neither oxyhemoglobin nor reduced hemoglobin is the toxic agent (19); but, rather methemoglobin (19) or, possibly, the stroma of lysed red cells may be the causative agent (73). It is also possible that a double cause is involved; that is, that these agents may be more toxic to, or only toxic to a kidney with an impaired flow of blood.

The problem of the toxicity of hemolyzed blood is intimately linked with the question whether alkalinization of the urine prevents renal damage. The first urine of patients with severe burns is almost invariably strongly acid, and immediate administration of alkali to the patient has been recommended. The purpose of this alkalinization is to prevent precipitation of the products of the destroyed red cells in the renal tubules in the presence of an acid urine (10). In most patients hemoglobinemia and hemoglobinuria, when first observed, have already been present for at least an hour before this examination is made, or before any alkalinization is possible. Consequently, there are no actual data available as to the prophylactic value of this treatment in human beings, and no experiments with animals are known. Although no evidence for or against the value of alkalinization on entry for this purpose has been found after careful studies at the Boston City Hospital, and the point is still controversial, we feel that it should still be used. Alkali treatment of burns for other purposes is not new but has recently been brought into great prominence by Rosenthal and by Fox. It will be discussed further under shock.

F. Pathology of the liver.

From the time of Bardeen's work there have been reports of liver necrosis in burns. Bardeen described a diffuse injury to all the liver cells. Following Wilson and his coworker's report in 1938 there began to be many reports of a different type of injury characterized by focal necrosis of the central cells of the lobules and by marked polymorphonuclear leucocytic infiltration of the necrotic areas. Wilson queried at that time whether the then popular tannic acid treatment had some causal relationship to this change. In 1941 Wells, Humphrey, and Coll, by clinical and experimental work, definitely showed that this peculiar necrosis was due to tannic acid poisoning. This has been confirmed by others (63, 93). It has also been shown that the method of application of the tannic acid influences the amount of its absorption and, therefore, the degree of liver injury (93). The forms of treatment that induce slow tanning such as tannic acid baths or tannic acid jellies and ointments are more dangerous than rapid tanning with tannic acid and silver nitrate solutions (18, 88, 155). However, as Lee points out, there is still some liver necrosis encountered in burns when no tannic

acid is used, but very few cases have been reported in which bland ointments, saline solution, or dry dressings have been used (63, 133, 176). A case of marked central necrosis of the liver has been seen when triple dye was used for the surface treatment (115).

Late liver damage, as evidenced by jaundice and decreased prothrombin concentration from 2 to 6 months after injury, has been seen in a number of patients who have received human plasma or whole blood (114). All of these patients recovered. Clinically these cases are similar to, and probably identical with, cases of homologous serum jaundice which are due to the transmission of a virus of infectious hepatitis in serum, plasma, or blood (172).

G. Pathology of the kidney.

Scattered pathological studies of the kidney in patients dying of burns have been made (131, 184, 194), the most recent being a report by Goodpastor *et al.*, who found a close correlation between clinical and laboratory evidence of kidney dysfunction, extent of deep burn, severity of shock, hemoglobinuria, and renal morphologic changes at postmortem. The most consistent anatomical changes were the following: on microscopic examination the glomeruli were normal and the tubules showed varying degrees of necrosis affecting principally the ascending and descending portions of the loops of Henle. Pigmented casts in the tubules were a constant finding in these cases. These casts have been considered to be derived from the breakdown of red cells, although direct proof of this is lacking. Some support to this conception is lent by the demonstration of hemoglobin, oxyhemoglobin, and methemoglobin in the blood and urine of all severely burned patients. In addition, casts composed of desquamated tubular epithelial cells have been found in most of the same cases. Evidence of regeneration of tubular epithelium was seen in most of the patients in this class who survived more than 72 hours.

In contrast with the marked microscopic abnormalities, the findings of gross examinations were essentially normal. In a few cases the kidneys were swollen, the cortices pale, and the medullae dark red, presenting prominent black, brown, or purple red streaks converging toward the papillae. These streaks corresponded to the tubules filled with pigment casts.

It is quite apparent from the description that the renal changes are similar to those following hemolytic blood transfusion reactions, traumatic shock, crush injury, and hemolytic sulfonamide reactions. Goodpastor *et al.* believe that the important etiologic factors of injury to the kidney in burns are the presence of marked hemoglobinemia, hemoglobinuria, and severe shock.

H. Pathology of the gastrointestinal tract.

The occurrence of ulceration of the intestinal tract following burns has been recognized for over 100 years. Curling directed special attention to this subject in 1842. Harkins (87) has recently reviewed the reported cases: "The occurrence of gastrointestinal ulceration following burns is more common that coincidence would allow. A severe third degree burn, often of a sloughing septic type, is most apt to result in such an ulceration. A decreased incidence of this complication may come from a more aseptic handling of burns. The only other therapeutic considerations are the realization of the possibility of these ulcers and institution of the proper medical or surgical treatment of them as is indicated. Up to the present time, no acute ulcer following burns has been treated surgically."

"Children and females are more often affected, but this may be because they are more frequently burned. The symptoms of such an ulcer may be of rapid onset and include epigastric pain, melena, and hematemesis. The average length of life in ninety-four cases with necropsy, collected from the literature, was 15.4 days."

"The ulcer involved the duodenum alone in seventy-one cases, the stomach alone in sixteen cases, and both organs in five cases. The ulcer was single fifty-seven times and multiple thirty-four times. Hemorrhage was twice as apt to be a fatal factor as perforation, and the pancreas was often exposed and the pancreaticoduodenal artery eroded." Thirteen reports of gastrointestinal ulceration with recovery are also mentioned by Harkins.

The etiology of the ulcers has not been determined. Various theories involving nervous, infectious, toxic, and embolic factors have been suggested (87). Necheles and Olsen studied the gastrointestinal secretions following burns, as the salivary, pancreatic, and biliary outputs were considerably diminished. The gastric secretions, however, were increased by several hundred per cent with an associated increase in gastric motility. These writers believe that these observations bring forth "new light on the problem of Curling's ulcer."

Actual ulceration of the gastrointestinal tract has been seen only once in the Boston City Hospital series of 60 recent autopsies. Therefore, Levenson *et al.* (115) think that it is a rare complica-

tion under the present modes of treatment. However, the same observers, as well as Mallory and Brickley, have confirmed the older observations of congestion of, and diffuse hemorrhage from, the upper gastrointestinal tract in human beings. They made these findings only in those patients with extensive burns and severe shock. In Levenson's series there were 6 instances of these findings but, as mentioned above, only 1 Curling's ulcer. Similar changes have been found more frequently in experimental animals, particularly the dog and calf (75). These changes were accentuated by preburn and postburn heparinization of the animals (75).

I. Respiratory tract.

Up to 1942, injury of the respiratory tract had occasionally been reported as a complication of burns. At that time injury of the respiratory tract assumed great prominence since the majority of the victims of a fire at a Boston night club (The Cocoanut Grove), in which about 500 people lost their lives, had suffered damage to their respiratory tracts. The clinical and x-ray aspects of these cases will be discussed later. Pathological examination (130) revealed that the respiratory damage was essentially that of a laryngotracheobronchitis. Three patients who were dead on arrival at the hospital were examined at autopsy, and all showed an intense but nonnecrotizing hemorrhagic tracheitis and bronchitis, and presented heavy voluminous lungs, from the cut surfaces of which fluid in large amounts could be expressed. Microscopic examination confirmed the presence of acute pulmonary edema and demonstrated in the upper tracheobronchial tree a serohemorrhagic exudation without significant leucocytic infiltration (130).

In individuals who died after varying periods of time in the hospital, (1 to 12 days) severe necrotizing tracheobronchitis was found, with the formation of a pseudodiphtheritic membrane. Many of the respiratory passages were occluded by the pseudomembrane and viscid, mucoid, and sanguineous exudate. Pulmonary damage consisted chiefly of congestion, edema, and scattered areas of atelectasis, emphysema, hemorrhage, and pulmonary infarcts. Pneumonia, chiefly due to the staphylococcus aureus, occurred infrequently, usually as scattered necrotizing lesions.

The etiology of the lesions has not been clearly shown. It is considered that the respiratory irritant was probably an integral part of the fumes and particles which resulted from the burning of the contents of the building. The victims who inhaled enough to render them unconscious sustained the severest respiratory damage (8, 68). Similar pathological findings were reported in the Cleveland Clinic fire of 1928 (141). However, special fires involving many people are not necessary to cause this type of lesion. Goodpastor *et al.* found 19 cases at autopsy on 40 patients dying of sporadic burns, and Levenson *et al.* (113) observed many patients who recovered in their series of 600 sporadic burns. The only factor in common to all of the patients was that they had inhaled much smoke. A few cases resulted from the inhalation of smoke from a fire involving only a bed.

J. Adrenals.

Weiskotten stated in 1917 that the most prominent and characteristic necropsy findings in patients with burns were changes in the adrenal glands. He described swelling, redness, and periadrenal edema with hemorrhage in all cases of more than 24 hours' duration. Microscopically there was necrosis of the cortical cells. Since then others (17, 142, 79) have reported similar findings in some, but by no means all, burn autopsies. The most recent report is that of Mallory and Brickley who found focal necrosis of the adrenal gland in 2 cases in which death occurred in from 2 to 3 days after the burn. They mentioned splitting of the cords of the outer portion of the cortex with accumulation of serous exudate in the space produced, pyknotic nuclei, acidophilic necrosis of the adrenal cells, and infiltration with polymorphonuclear cells.

The finding of depleted cortical lipoid, particularly cholesterol, following burns has been recently confirmed by Sayers *et al.* who state that in burns the adrenal glands are stimulated to exhaustion by the adrenotropic hormone of the anterior pituitary lobe. Harkins (90) has stated similar findings and conclusions.

K. Spleen and lymph nodes.

Bardeen described swelling and necrosis in the lymphoid nodules of the lymph nodes, peripheral lymphoid tissue, and spleen, which he considered characteristic of burns and indicative of toxemia. These observations were made in children, all of whom died from 4 to 9½ hours after injury. In a recent review of 96 burn autopsies, Baker focused attention on the presence of karyorrhexis (nuclear fragmentation) of the cells in the lymph cords. He found that high degrees of karyorrhexis were found only in children dying within 3 days; more than minimal karyorrhexis was not encountered in a single subject beyond adolescence.

Baker raises the questions whether the karyorrhexis is pre-existent to the burn, i.e., a normal finding in children, and whether its absence later is not the abnormal feature. Further studies are required to clarify this point.

L. Heart.

Kayashima found that after experimental burns in rabbits, electrocardiograms were abnormal. The waves were low in amplitude, the T wave was flattened out, and the ventricular complex tended to be monophasic. Similar changes were observed by the same author in 12 Naval casualties (from 21 to 37 years of age) with from 12 to 20 per cent body surface burns who recovered. Histologically, interstitial myocarditis with perivascular infiltration of leucocytes was observed in the rabbits. Buis and Hartman reported 2 cases in human beings (among 6 autopsies) of microscopic fragmentation of the myocardial muscle fibers.

M. Pathology of the central nervous system.

Delirium, stupor, coma, convulsions, hyperpyrexia, and Cheyne-Stokes respiration, signs which may indicate central nervous system injury, have been described following extensive burns. There have been very meager reports on the pathological changes of the nervous system. Wilson in reporting on a series of extensive scalds and burns mentioned "toxic damage" in the brain in occasional cases but did not localize the lesions. Pack quoted Crile as saying that the central nervous system injury was seen only as a result of profound shock. Mallory and Brickley reported cortical ganglion necrosis in 1 of the Cocoanut Grove cases, but the patient had suffered from severe anoxia in addition to external burn. She had evidence of carbon monoxide poisoning, shock, and severe respiratory injury, the first two causing anoxia from the start and the latter causing it later.

Walker and Shenkin have reported on 6 patients who were observed to die of sudden respiratory arrest. All their patients showed essentially the same signs clinically: disorientation and mania or stupor, with abrupt failure of respiration but without obstruction of the airway. Five of the patients died about the fourth day, but the sixth died on the sixty-second day. Postmortem examination showed cerebral edema with evidence of marked increased intracranial pressure including widening of the gyri, narrowing of the sulci, herniation of the temporal uncus through the incisura of the tentorium, and herniation of the cerebellar tonsils into the foramen magnum. There were marked changes in the smaller blood vessels consisting of degenerative changes of the endothelial lining, with occasional breaks and perivascular petechial extravasations. The ganglion cells throughout the brain showed toxic degeneration, but the most striking changes were in the cortex and hypothalamus, particularly in the latter.

According to these authors the pathogenesis of these lesions is not clear. Anoxia or the presence of a circulating toxin (32) as suggested by Christophe must be considered. He showed by cross circulation experiments that changes occurred in the paratuberian centers especially at the paraventricular and supraoptic regions of the anterior thalamus. It should be borne in mind, however, that Walker and Shenkin's patients showed generalized edema as well as cerebral edema, and it is possible that the cerebral changes are a secondary effect. Many additional studies are needed to clarify these points. Unfortunately the few autopsies that have been done on burned patients have seldom included an examination of the head.

METABOLIC CHANGES IN BURNS

A. Electrolyte metabolism.

The findings of a decrease in plasma chloride concentration in the first few days following an extensive burn, first reported by Davidson in 1926, has since been confirmed by a number of workers (32, 180, 163, 179, 70, 44, 177). These later studies have also demonstrated a decrease in serum sodium concentration, and a decrease in urinary sodium and chloride excretions. Fox and Keaton, Cope (44), and Hirshfeld (95), using radioactive sodium, have confirmed Underhill's, Rudler's, and Lowdon's findings that much of the lost sodium chloride went into the burned area.

A shift of some sodium into the injured cells in the burned area with a shift from the injured cells of an equivalent amount of potassium has been demonstrated by Fox and Keaton and Tabor and his associates (170). The actual rise in circulating plasma potassium concentration is small and well below the toxic range for normal animals (196). However, Tabor (171) has shown that the shocked animal is considerably more sensitive to rises in plasma potassium concentration than the normal animal.

B. Nitrogen metabolism.

Cuthbertson first noticed in 1930 that patients with fractures excreted abnormally large amounts of nitrogen in the urine for weeks after the injury and that this was associated with a loss of weight

and muscle wasting. Lucido noted a similar process in a burned patient. His observations were amplified on large numbers of patients in a group at the Boston City Hospital (114) during the last 3 years. It was found that all severe burns that were neither anuric nor too severely oliguric had a high output of nitrogen in the urine during the first 3 weeks, and that in a few cases this output continued for many months. Steady losses of from 25 to 30 grams of nitrogen per day have been observed frequently, and on an occasional day the loss may be as high as 45 grams. This early increase in urinary nitrogen excretion has also been reported following any acute trauma, poisoning, or infection (25, 59, 99, 125). The cause of the excessive nitrogen excretion has not been finally determined. There may be more than one precipitating factor. Associated with the high urine excretion is an early high nonprotein nitrogen level in the blood which is the result not only of a decrease in kidney function (transient or permanent) but also of an increased production of nonprotein nitrogen products (76). Clearing of the increased nonprotein nitrogen accounted for only a small fraction of the total urinary nitrogen increase. In severely burned patients there is destruction of large amounts of tissue followed by autolysis and absorption of its products. There is also the possibility that the protein catabolism is increased by the absorption of specific substances from the burned areas (139) and from the so-called "toxic degeneration of protein" associated with fever and infection (149). Increased gluconeogenesis may be responsible for part of the increased protein breakdown. Browne postulates an increased production of "S" hormone by the adrenal cortex and simultaneously a decreased production of "N" hormone which results in an increased protein breakdown as a step in the formation of glucose. In any event it has been recently shown that marked abnormalities of the carbohydrate metabolism do occur in severely burned animals (34) and human beings (176), and are associated with hyperglycemia, lactacidemia, and a lowered carbon dioxide combining power. This will be considered in more detail later.

Harkins *et al.* (92) found in rats a rise in plasma amino nitrogen, a slight rise in plasma ammonia nitrogen and liver amino nitrogen, but no change in liver ammonia nitrogen or liver amide nitrogen. Taylor *et al.* (177) studied the plasma amino acids in human beings and found rises only in patients with extensive burns who were in shock.

Taylor and his associates (175) have confirmed the findings of Christophe, Duval *et al.*, and Lambert and Driessens that a large part of the early increased nitrogen, both in the blood and urine, is due in some cases to the presence of abnormal amounts of "residual nitrogen," in addition to an increase of normal substances such as urea, creatine, creatinine, and amino acids, that are found in the normal blood and urine. Satisfactory chemical characterization of the compounds has not been made.

At the same time that from 25 to 30 grams of nitrogen are being excreted in the urine, an additional 30 to 40 grams of nitrogen may be lost from the surface of the burn daily (178, 98, 48). Such important losses of nitrogen from the surface are commonly seen only in extensive deep burns, but in these the losses may continue over long periods of time. Early after superficial burns there is a large outpouring of plasmalike fluid through the skin. This contains a high proportion of protein. Later, during the sloughing and granulating stages of deeper burns there is a steady and considerable loss of protein in the form of purulent material from the surface. The amount of loss varies directly with the area involved. These losses continue until healing is complete. Such losses from surfaces and wounds have not, in the past, been considered in calculating conventional nitrogen balances, and it must be realized that errors of great magnitude may be introduced into such studies unless this factor is considered.

While the large quantities of nitrogen are being lost in the urine and in the drainage from the wounds of such patients, the protein intake is likely to be greatly reduced by reason of pain, anorexia, and poor gastrointestinal function. The negative nitrogen balance occurring under these conditions may have serious effects in a few days in the patient with already depleted body protein, and in a few weeks in a patient with excellent protein nutrition. This is reflected in the development of a progressive hypoproteinemia. This is an extremely serious metabolic sign. During the first week following a burn a transitory hypoproteinemia may be present; it is due to shifts of water, electrolyte, and protein from the blood stream into the subcutaneous tissue or exudate. This early hypoproteinemia is without nutritional significance. On the other hand, a continuous fall in plasma proteins after the first week is a sign of marked tissue protein deprivation. Unless remedial steps are taken early, weight loss, edema, loss of strength, and death from malnutrition ensue. Methods to combat this process will be discussed.

C. Carbohydrate metabolism.

Hyperglycemia, lactacidemia, and lowered carbon dioxide combining power are frequently found

in human beings and animals following burns (54, 180, 127). The extent and duration of the changes in these blood constituents are roughly proportional to the severity of the burn. Clark and Rossiter, working with rats, and Greenwald and Eliasberg (79), working with rabbits, found decreases in the muscle glycogen following burns. Similar determinations have not been made in human beings. Any increase in lactic acid production due to an increase in the rate of muscle glycogenolysis may result in hyperglycemia through conversion of the lactic acid to glycogen and glucose in the liver. The rate of lactic acid formation following burns is, however, apparently greater than the liver can handle, resulting in lactacidemia as well as hyperglycemia. In addition to an increased glycogenolysis, another possible source of the extra blood sugar is glucose derived from protein (24).

Many investigators have emphasized the role of the adrenal glands in the production of abnormalities in the carbohydrate metabolism in burns. Hartman (94) has demonstrated an early increased adrenalin production. Browne and Cope *et al.* (47) found increased 17-ketosteroid excretion in the first few days following burns, which was followed by a decrease below normal values. Numerous pathological studies, as already mentioned, have revealed adrenocortical hypertrophy and marked depletion of lipoids. Adrenalectomy was found by Slocum and Lightbody to prevent the lactacidemia but not the hyperglycemia in burned rabbits, while Clark and Rossiter found that neither the lactacidemia nor the hyperglycemia was abolished. It appears that although the adrenal glands may play an important role in the production of abnormalities in carbohydrate metabolism following burns, the entire picture cannot be explained on this basis, and, indeed, the effect of the adrenal glands may be of a secondary nature.

D. Vitamins.

Increased demands for vitamins in burns have been suspected for some time by analogy with studies showing increased needs for vitamins in other diseases (81). Empirically, vitamin preparations such as cod liver oil have been used locally (121) and orally for many years in the treatment of burns. Very few assays of vitamins in the blood, urine, or tissues to determine the actual requirements in burns have been made.

In 1937 Usbekov studied the content of ascorbic acid in the adrenal glands and in the liver of guinea pigs that were kept on various diets before and after burning. He found a progressive fall in the ascorbic acid level in these organs following burns of from 45 to 50 square centimeters of skin. This decrease occurred in all animals no matter whether their diets were high or low in ascorbic acid. The pigs on partially deficient diets showed indolent healing and "poor" granulation tissue and lost much weight. The animals on better diets lost less weight and had "better" granulation.

Lam reported low plasma ascorbic acid concentrations in a few patients with extensive burns. Clark and Rossiter, and Harkins (90) reported a decrease in adrenocortical ascorbic acid concentration following burns in rabbits, rats, and guinea pigs. Lund, Taylor, Johnson, and associates have studied plasma ascorbic acid concentrations and urinary excretions of ascorbic acid, thiamin, riboflavin, and n-methyl-nicotinamide in man in the acute and chronic stages of burns. They have found that in patients with severe burns on high protein diets supplemented with two or three times the National Research Council daily allowances of these vitamins recommended for healthy individuals (38), the plasma level of ascorbic acid and the urinary excretions of all four vitamins may decrease to very small quantities. Even with small burns the patient on a nonsupplemented house diet may do the same thing. In patients with consistently low plasma and urine ascorbic acid levels the granulation tissue is absent or edematous, skin grafts fail, and epithelization is delayed. Burned patients with low excretions of B vitamins may have poor appetites, poor bowel function, asthenia, and poor morale. The extra needs for vitamins commence with the burn and remain until healing is complete. In general the extra amounts needed to prevent depletion parallel the area of unhealed burn. Whether it is desirable to try to maintain fully saturated levels of ascorbic acid in the blood and the excretion of appreciable quantities of all four vitamins in the urine is not known. The maintenance of such levels will, in very severe cases, entail the administration of up to 2.0 grams of ascorbic acid, 50 milligrams of thiamin, 50 milligrams of riboflavin, and 500 milligrams of niacinamide. Comparable studies on any of the fat soluble vitamins and on all other water soluble vitamins have not been made.[1]

BURN SHOCK

Burn shock may be defined as a condition of low blood plasma volume, low cardiac output, low blood pressure, and increased peripheral re-

[1] Since this was written Andreae and associates have reported studies of the balance of riboflavin in burns and have found an increased need for it during convalescence.

sistance to blood flow. The four factors that have for a long time been considered important as causes of burn shock are: loss of circulating plasma, toxic substances in the blood, pain, and cold. The two former are now considered to be of prime importance and the two latter to be, at most, of minor contributing influence. Shock following a burn may be expected in cases of normal adults with a burned area of 15 per cent or greater and in cases of feeble adults or children with a burned area of 8 per cent or greater. As burn shock is frequently fatal if untreated, it is a subject of great importance and will be considered in some detail. Until recent effective methods of treatment became available most patients who died, died in shock. Now they die later.

A. Causes.

1. Loss of circulating plasma. The most important cause of burn shock in most cases is the loss of plasma from the circulation into the tissues of the burned area and through the burned area. That such losses are large and that the plasma volume is greatly reduced have been postulated for many years because of the severe degree of concentration of red blood cells that has been observed. The first direct quantitative measurement of the reduction of blood volume in burned animals in shock was made by Johnson and Blalock in 1931. They found that the amount of blood that could be removed from such an animal before death was very small. This amount they named the "bleeding volume." At the same time they measured very large amounts of fluid in the tissues under the burn. Harkins (85, 86) amplified these experiments and correlated in more detail the relationship between "bleeding volume" and blood volume. A more accurate, direct method of demonstrating the blood volume changes in shock was presented by Gibson and Evans in 1937, and a modification of their method was used in the study of human burn shock by Cournand and his associates. They found a very consistent correlation between the reduction of the plasma volume and blood pressure on one hand and the increase of the hematocrit level on the other. Recent work of Lischer *et al.* and at the Boston City Hospital shows that net losses from the plasma continue at most for 48 hours. Beginning immediately after the injury, some edema fluid and some other interstitial fluid flows into the vascular system and these increments reach an equilibrium with the losses if the patient survives this length of time. Glenn, Peterson, and Drinker have measured the greatly increased flow of lymph from the burned area.

Chart No. 1 illustrates the course of the hematocrit and hemoglobin changes in a patient with a dermal burn of the hands and face only (7% of the body area) who at no time developed clinical shock.

As may be seen from the chart, the initial hematocrit and hemoglobin 1 hour after injury were already markedly elevated which demonstrated that the fluid loss may be very marked at first. During the first day the patient received no parenteral fluids. His oral intake was 2 liters and his urine output 350 cubic centimeters. At the end of 24 hours his hematocrit and hemoglobin had risen still further, reaching 63 per cent and 135 per cent, respectively. During this time there was very little external oozing of plasma, but an increase in the amount of subcutaneous edema of the face and neck was visible. During the second day the edema began to subside, and simultaneously the hemoglobin and hematocrit levels began to fall. By the fifth day, the edema had disappeared and the hematocrit and hemoglobin had returned to normal. During this time the plasma nonprotein nitrogen concentration remained normal while the total protein and albumin concentrations showed slight falls.

Comparing the reduction in blood volume to other possible causes of burn shock Rossiter has recently concluded: "It is, therefore, probable that these enormous losses of plasma from the bloodstream will initiate shock. Even should this prove but one of a number of initiating factors it is one of immense importance and one which justifies vigorous countermeasures."

2. Toxins. The literature concerning the toxic factor or factors in burn shock is voluminous and very controversial, although few authors have been positive in their denial of such a possible contributing factor. Christophe by some very ingenious cross circulation experiments in dogs showed that circulating toxins injured the brain and led to death. This he described as a "typical burn death." Certainly some of the chemical changes associated with these deaths indicate the probability that the dogs were in shock at some time prior to death although he does not make specific mention of it. Another demonstration of burn shock apparently produced solely by toxic factors and unassociated with plasma loss has been made very recently on rats by Prinzmetal and his associates. He found that rats which were mildly burned at 75 degrees C. for 10 seconds on a single hind limb developed marked visible edema with considerable local fluid loss but did not develop shock. On the other hand, rats whose single hind limbs were severely burned at 100

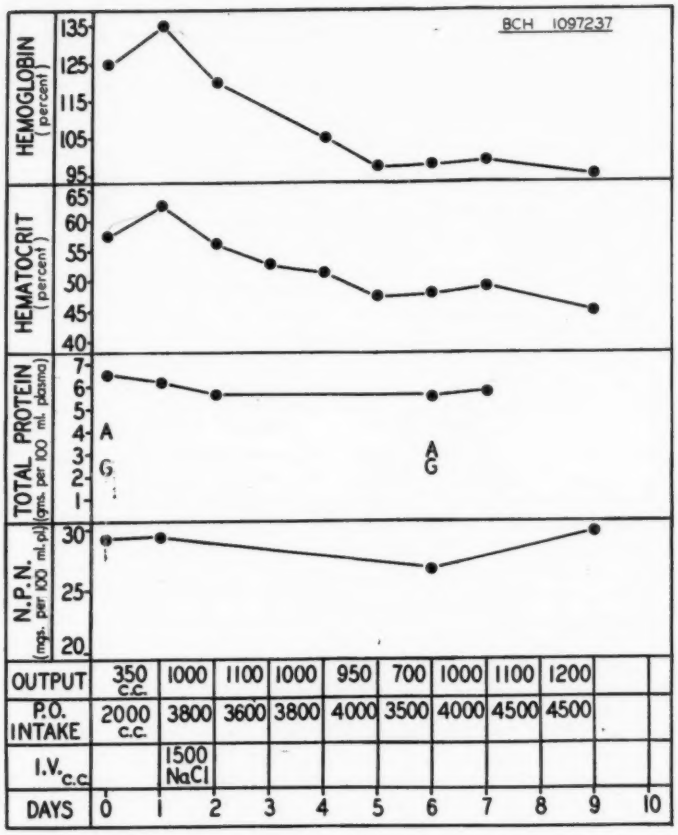


Chart 1. Hematological changes in patient with burn of face and hands and without shock.

degrees C. for from 2 to 3 minutes died in shock without visible edema and exhibited insufficient local fluid loss to account for death. Similar results were obtained when larger areas of the body were severely burned for 10 seconds. These authors concluded, "It is, therefore, apparent that there are at least two mechanisms capable of producing shock; one due to local fluid loss and the other due to some unknown factor."

Another important contribution to our knowledge concerning toxins has been made by Perlman, Glenn, and Kaufman who described a large amount of a new globulin fraction in the lymph collected directly from the burned area in calves. This globulin may represent a toxin.

Rawlinson and Kellaway have found great increases in phosphatase, phosphate, proteolytic enzymes, esterase, and catalase from heated liver slices as the temperature approached 50 degrees C. Kellaway and Rawlinson studied tissue injury by heat in isolated limb preparations. From the perfused hind limbs of guinea pigs and the forelimbs of cats histamine was liberated between 45 degrees and 50 degrees C. In the early hours of perfusion a substance relaxing smooth muscle which inhibited the stimulating effect of histamine was present in the perfusate. No active adenyl compounds could be detected between 37.5 degrees and 50 degrees C., but cardiodepressant activity was found between 42 degrees and 50 degrees C. This was also present in the subcutaneous edema. It was heat stable and was not diminished by incubation with cat muscle or cat liver extracts. The hydrogen ion concentra-

tion of the perfusate showed its greatest increase between 44 degrees and 45 degrees C. The small output of inorganic phosphates between 37.5 degrees to 41 degrees C. was markedly increased at the higher temperatures. Alkaline phosphatase, lipase, and proteolytic enzymes were also set free above 41 degrees C. These authors concluded: "The demonstration that lipase and proteolytic enzymes were set free from the perfused hind limb of the cat above 41 degrees C. gives color to the possibility that toxic products may be formed by enzymatic activity in the tissue spaces." Proteolytic enzymes in lymph from the burned area have also been reported by Zamecnik *et al.*

Rose and Browne have found very high blood histamine levels immediately after the burn. The amount of histamine present decreases rapidly as toxemia develops. These findings are not altered by the administration of sufficient plasma to prevent hemoconcentration. There is a correlation between the degree of injury and the decrease of the histamine content of the blood. Thus, the most marked decrease has been noted from 12 to 36 hours before death. Similar findings have been observed in cases of fatal shock.

Beloff and Peters have found a proteinase that is liberated from burned skin that they discuss in relation to "burn toxin theories," but they do not claim that it causes burn shock.

Muus and Hardenbergh have observed that the oxygen consumption of normal rat liver slices is increased when measured in lymph from the burned legs of calves or one dog as mediums. The increase over similar measurements in normal lymph was as great as 41 per cent. When serum was collected after burning a smaller increase was found. In this connection Taylor and his associates (176) have found an increase in the basal metabolic rate in severely burned patients. The rise was greater than could be accounted for by the fever that was present at the time of the test.

Aub (7) has found that the fluid obtained from within the sheath of a muscle that has been made ischemic by the interruption of its circulation produces shock when injected into normal dogs. Exotoxins produced by organisms of the bacillus welchii group were found in this fluid. These bacilli were found to be normal inhabitants of normal dog muscle. Under the anaerobic conditions of these experiments the number of organisms and the amount of toxins produced are greatly increased. The toxic effect of this fluid is nullified if suitable antitoxin is mixed with the fluid, or injected separately but simultaneously into the dog. Animals immunized with toxoids are resistant.

Chaikoff and his associates have found that fluid expressed from the skin and subcutaneous tissue of burned areas in dogs is toxic to rats. Gram positive anaerobic bacilli and other organisms have been identified in this fluid. After Zeitz filtration the fluid is still toxic in most instances. Aub has found that these anaerobic organisms are not normally present in the tissues of man. At present there is no evidence that these toxins are important in the pathogenesis of burn shock in man.

This discussion of burn toxins in relation to burn shock is far from complete and mentions only a few of the important studies that have been made. There seems to be no doubt that many chemicals are released from the area of a burn that all together play a part in the depression of the circulatory system after a burn.

3. Pain. At the moment of burning and for a few minutes after, burns cause sharp pain. Then there follows during the next few hours and, even occasionally, for several days, a period of almost complete freedom from pain. At later stages burns may be among the most painful of all diseases. Until recently, pain has been considered to be a very important cause of shock following burns. Many experiments have been carried out to evaluate the importance of pain as a factor in various other forms of shock, but in burn shock the only experiments of this kind are those of Kabat and Hedin. Unfortunately, their experiments on dogs are inconclusive for several reasons, particularly because their burns did not produce shock but merely produced a moderate rise in the hematocrit. Recently the experimental evidence from studies of afferent stimuli as a factor in the production of traumatic shock has indicated a much smaller influence from such stimuli than the many older studies, such as those of Crile, indicated. From an excellent recent study of traumatic shock in dogs Phemister and Laestar conclude, in part, as follows: "No evidence was obtained from these limb trauma experiments that . . . a flow of nociceptive stimuli from the injured field . . . is an important contributing factor in the initiation of any circulatory impairment or shock which followed."

Evidence derived from the treatment of patients with burns in shock shows that, even in the exceptional instances with severe pain, sedatives have essentially no therapeutic effect on shock comparable to the effects obtained with suitable intravenous fluids such as will be described.

4. Cold and heat. Under war conditions and in connection with civilian airplane accidents some patients with burns suffer from exposure to

cold or heat for long periods of time before and after an accident. In peace time civilian life, such complications are only seen in disasters of the first magnitude or in the case of individuals living under isolated conditions. Either excessive cold or excessive heat will contribute to the severity of shock, but quantitative studies of the role played by cold and heat have not been made. Some very important observations on the treatment of burn shock in a chilled or heated environment will be considered in the section on the treatment of shock.

B. The diagnosis of burn shock.

Many writers have described the clinical picture of burn shock. As with other forms of shock it is very simple to make the diagnosis in its final stages. One merely has to determine that the pulse and blood pressure are unobtainable. However, the earlier periods of impending or mild shock are more difficult to diagnose. Since shock, once it is well established, is much more difficult to treat than when it is in its earlier stages, it is important to foresee impending shock so that prophylactic measures can be taken.

Careful estimation of the area and of the approximate depth of a burn is important for the anticipation of shock. As already mentioned, any patient with a burn area of 15 per cent or greater will probably suffer from shock and any patient with a burn area of 25 per cent will probably suffer from fatal shock unless prompt and active treatment is given.

The pulse and blood pressure should be taken at one-half hour intervals during the first 24 hours. However, they are not good indicators of impending shock, since because of the increased peripheral resistance the pulse may remain slow and the blood pressure normal when the blood volume has already been reduced to a critically low level. Suddenly the blood pressure will fall to a dangerous level and even then the pulse may not rise.

Direct blood volume determinations are the best indications of reduced blood volume but they are not practical for clinical work. Hematological determinations are practical and serve as essential guides. Hematocrit, hemoglobin, and red blood cell determinations are useful. Except for research purposes serial determinations at 2 to 3 hour intervals of any one of these is sufficient. The blood examined must be venous rather than capillary blood because of stagnation in the capillaries.

As indicated in Table II apparently normal hematological findings may be seen in the presence of severe loss of plasma in a previously anemic patient. Note in Table II that a slightly elevated hemoglobin of 110 per cent, if found in a patient whose preburn hemoglobin was 70 per cent, indicates that he has already lost 53 per cent of his plasma volume and 37 per cent of his blood volume, a loss that would probably cause severe shock.

TABLE II.—CALCULATED CHANGES IN BLOOD AND PLASMA VOLUMES ACCORDING TO CHANGES OF THE RED BLOOD COUNT, PER CENT OF HEMOGLOBIN, AND PER CENT OF PACKED RED BLOOD CELLS IN PATIENTS WITH VARYING DEGREES OF ANEMIA BEFORE INJURY

	Observed				Calculated	
	Hemoglobin	Red Cells Millions	Red Cell Volume Per cent	Plasma Per cent	Volume Per cent Loss	Blood Volume Per cent Loss
Original	100	5.0	45.0	55.0	0	0
Final	120	6.0	54.0	46.0	30	17
Hgb. 100	140	7.0	63.0	37.0	52	29
Per cent	160	8.0	72.0	28.0	68	37
Original	90	4.5	40.5	59.5	0	0
Final	110	5.5	49.5	50.5	30	18
Hgb. 90	130	6.5	58.5	41.5	52	30
Per cent	150	7.5	67.5	32.5	67	40
Original	80	4.0	36.0	64.0	0	0
Final	100	5.0	45.0	55.0	31	20
Hgb. 80	120	6.0	54.0	46.0	52	33
Per cent	140	7.0	63.0	37.0	67	43
Original	70	3.5	31.5	68.5	0	0
Final	90	4.5	40.5	59.5	33	22
Hgb. 70	110	5.5	49.5	50.5	53	37
Per cent	130	6.5	58.5	41.5	67	46
Original	60	3.0	27.0	73.0	0	0
Final	80	4.0	36.0	64.0	34	25
Hgb. 60	100	5.0	45.0	55.0	55	40
Per cent	120	6.0	54.0	46.0	68	50

Serial plasma protein determinations also provide useful information. As plasma is lost from the vascular bed, there is a shift of low protein, extravascular (chiefly interstitial) fluid into the blood stream. This results in dilution of the plasma protein. If the shift is rapid, there is a greater fall in the plasma protein concentration than in the hemoglobin concentration. In some instances the hemoglobin may remain normal, and a falling plasma protein may be the chief laboratory indication of impending shock.

Accurate records of urine output must be kept. Lauson *et al.* have shown that renal blood flow and urine output may be markedly reduced at a time when the peripheral pulse and blood pressure are normal. If the urine output is good, one may feel sure that the general circulation is good; if, however, the output falls, one must anticipate early failure of the general circulation.

C. Secondary effects of burn shock.

The effects of severe burns without shock and of severe shock without burns are similar in many instances. For instance, increases in the blood sugar, lactic acid, nonprotein nitrogen, amino acids, ammonia, and hydrogen ion concentration, and decreases in sodium chloride and ascorbic acid are common to both. When shock occurs in burns it results in an intensification of the same changes that had already commenced before the shock had started. Quantitatively the severity of these metabolic changes parallels the severity and duration of the shock. One metabolic change, however, has been recently observed in shock of various types, including burn shock, that is never seen in burns, no matter how severe, if shock is prevented by efficient treatment. Tagnon and his associates (174) have demonstrated the occurrence of fibrinolysis in both burn and hemorrhagic shock. Fibrinolysis is the spontaneous dissolution in vitro of the clots in blood within 24 hours. This phenomenon disappears promptly with recovery from shock.

Another complication of burn (and other forms of) shock is "irreversible" shock. As a result of the anoxia and cellular injury that results from prolonged circulatory insufficiency, a point is reached where complete restoration of the blood volume will no longer result in the return of a sufficiently adequate circulation to maintain life. If the systolic blood pressure remains below 50 mm. for more than 3 or 4 hours the shock is almost surely "irreversible," and frequently it may become so in a shorter period of time. Studies have not been made on "irreversible" burn shock, but studies (66) on "irreversible" hemorrhagic shock have indicated that failure of liver function is one of the earliest and most important changes that lead to "irreversibility." There has been discussion in the past of the role of generalized capillary leakage as a factor in the initiation of "irreversible" shock. Some observers have claimed that it was important, and others that it did not occur. Fine and Seligman (67) have demonstrated why both sets of observers may have been correct in their observations under the limitations of their particular experiments. They have shown that there is no capillary leakage at a distance from the burn or other trauma, or at any place, when hemorrhagic shock is studied, from the commencement of shock or during the whole time that the blood pressure is very low. However, if the shock period has been long enough, generalized capillary leakage starts as soon as the blood pressure is brought up by restoration of the blood volume. This leakage under these conditions may be one of the major factors in determining "irreversibility." Because of the great danger of "irreversibility" it is imperative to prevent shock when possible and to treat it promptly and vigorously when it occurs.

D. The prevention and treatment of burn shock.

The first principle of treatment of any form of shock is to avoid, in so far as possible, any treatment of the patient that will increase the shock, and to postpone necessary shocking procedures (such as dressings) until shock has been prevented or treated. The positive measures for the treatment of shock are taken up first. Of these measures, those that restore and maintain the blood volume are of paramount importance and are discussed first. Omission of them can in no way be compensated for by any of the adjuvant methods of treatment discussed later.

1. Human plasma and serum. In burns, as indicated previously, the fluid that is lost from the vascular bed is similar in composition to blood plasma. Consequently, it is logical to replace the lost fluid with plasma, and it has been demonstrated that burn shock may be prevented or successfully treated in nearly all cases if seen early, by plasma transfusions in adequate amounts.

The amount and rate of plasma administration depends on many factors. First, it should be borne in mind that the amount of fluid lost is roughly proportional to the area of surface burn. However, burns of certain areas, such as the face and genitalia, which are highly vascular and have loose subcutaneous tissue, are accompanied by particularly high fluid losses. Second, the rate of fluid loss is maximal in the first few hours after a burn and then gradually decreases so that at the end of from 36 to 48 hours an equilibrium is reached between the amount of fluid lost and the amount returned to the blood stream from the interstitial spaces. Third, both clinical and laboratory data must be considered in determining the amount of plasma to be given.

Progressive hemoconcentration, falling plasma protein concentration, falling blood pressure, and a rising pulse are indications of impending shock. There are many formulas suggested for estimating the plasma dosage based on blood concentration (20, 58). The most commonly used is that of Harkins (89): (a), give 100 cubic centimeters of plasma for every point that the hematocrit exceeds the normal of 45 per cent, or (b), give 50 cubic centimeters of plasma for every point that the hemoglobin exceeds the normal of 100 per cent.

As pointed out previously, such calculations, based on an assumed normal hematocrit, may be

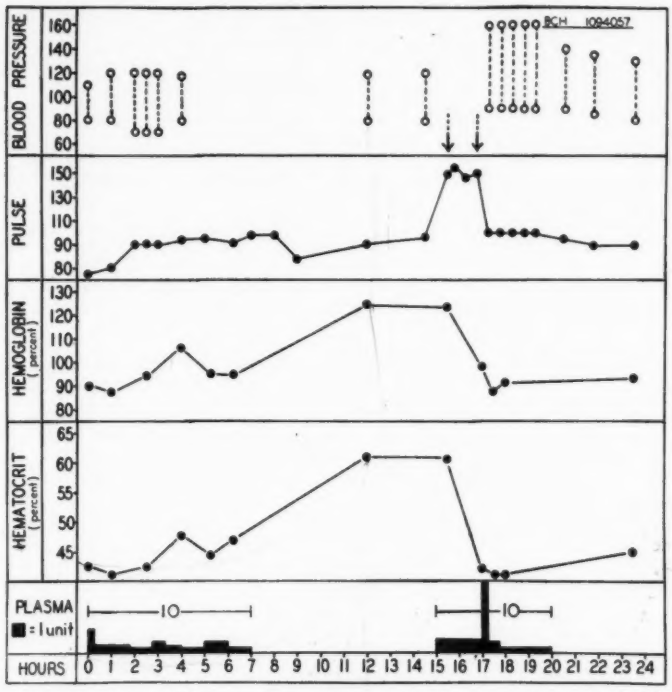


Chart 2. Effect of plasma on burn shock. Blood pressure was not obtainable. (The vertical arrows mean that the blood pressure is not obtainable.)

erroneous if the patient is anemic prior to injury. Serial hematocrits should suggest this possibility, and calculations should be based on an approximate preburn hematocrit. In addition, such calculations do not indicate the amount of plasma that will be needed to manage the entire course of the burn shock. Consequently, frequent hematological observations must be made during the first 24 to 48 hours. This is well illustrated in Chart 2.

The patient whose course is outlined in Chart 2 was a man of 50, with flame burns of 55 per cent of his body surface, chiefly deep. His blood pressure, pulse, hematocrit, and hemoglobin were normal on entry. Ten units (2,500 c. c.) of plasma were given in the first 7 hours, during which time his burns were treated with tannic acid and silver nitrate. His hemoglobin, pulse, and blood pressure remained normal, and plasma infusion was stopped. Five hours later, his hematocrit and hemoglobin were markedly elevated, but his pulse and blood pressure were still normal. During the next 2 hours the patient became chilly, nauseated, and complained of feeling sick. Suddenly he became cold, pale, and clammy. His pulse was very rapid and thready, and his blood pressure was unobtainable. The administration of 1,100 cubic centimeters of plasma during the next 90 minutes restored the hematocrit to normal, but had no effect on the pulse and blood pressure. In the next 10 minutes 800 cubic centimeters of plasma were given into the femoral vein by the multiple syringe technique, with a return of the pulse and blood pressure to normal.

This illustrates the necessity of administering plasma rapidly when shock is present. Advantage of rapid infusion in shock is also implied in the recent publication of Kohlstaedt and Page who advised intra-arterial rather than intravenous administration of fluid. However, one may construe the efficiency of their intra-arterial administration of plasma to a more rapid administration. Caution must be used, of course, in infants, old people, and those with heart disease. In the normal adult with a large burn, as much as 2,000 cubic centimeters may be given in a period of an hour without danger of overloading the circulation.

The dosage of plasma on the basis of the extent and location of the burn is also of value, particularly where laboratory facilities are not available. About 100 cubic centimeters of plasma for each per cent of body surface burned should be administered to patients with 10 per cent or more area burn. All of this plasma should not be given at once but should be given according to the following schedule which approximates the rate of fluid loss: one-half should be given in the first 4 to 6 hours, one-quarter in the next 6 hours, and the last quarter in the next 12 hours. Smaller amounts may be required in the next 24 hours in rare instances.

Attention should be paid to the clinical appearance of the patient. One of the best guides of adequate therapy of shock is a good urinary output. If a clinical impression of additional plasma need is at variance with the laboratory findings, the latter should be disregarded. The first 6 hours following a severe burn are critical ones so far as plasma administration is concerned. It is during these first few hours that the physician has the greatest opportunity to prevent shock. No unnecessary delays should be tolerated. When the usual peripheral veins are not available, there should be no hesitation about employing the femoral route or in cutting down on a vein. The use of the femoral route was a lifesaving measure in the treatment of many patients at the Boston City Hospital where at least a thousand of such punctures have been made for withdrawing blood or injecting various solutions intravenously.

Another factor influencing the amount of plasma required is débridement. It is common experience that large amounts of fluid are lost from the body during such procedures as débridement and the cleansing of large burns. The burned skin, although badly damaged and partially permeable to plasma, nevertheless acts as an important dam to the extravasation of fluid because of the coagulation of exudates and partial drying of them on the surface. The removal of this barrier and consequent opening of tissue spaces is accompanied by an increased fluid loss.

This may be seen by examination of Chart 3.

The patient, whose course is described in Chart 3, was a 32 year old woman with flame burns of 65 per cent of her body surface, chiefly deep, who was treated initially with 7 units (1,750 c.c.) of plasma given over a period of 1½ hours. At this time she went into shock despite the absence of significant hemoconcentration. It was known that her hemoglobin prior to injury was about 85 per cent. After a further period of 2 hours, during which time she continued to be in shock, infusion of plasma was recommenced and the patient responded with a rise of blood pressure to normal. While the infusion was still being administered, débridement was begun. During the course of the operative procedure both the hematocrit and hemoglobin rose abruptly, which indicated a considerable increase in the rate of fluid loss. Wilson *et al.* who used cleansing and débridement routinely prior to tanning, commented on such fluid loss and pointed out the high incidence of shock following this procedure.

Serum may be used in place of plasma with equally good results, as has been demonstrated by its use in large series of cases in Canada and Great Britain. The reactions which were reported in the early days of serum have not been seen in the later series of cases. Most of the early reactions may have been due to the fact that fresh serum contains thrombin and other substances which are toxic. After a few hours, and certainly after the 2 weeks during which the serum is now held before use, such substances have disappeared.

2. Human albumin. As a result of the work of Cohn and his associates, the United States Navy and the American Red Cross have produced large amounts of human albumin for the treatment of shock. Very little has been available for civilian use to date. A few reports indicate that it has value in the treatment of burn shock (101). At present it is shipped in highly concentrated form (25%), and can, if indicated, be administered without dilution. For emergency treatment of the patient who is not dehydrated it may well prove to have some definite advantages over plasma. It has the advantage that it has a much greater osmotic effect on the circulation than the same amount of protein in the form of plasma. However, it has the disadvantage of being a "pure" solution, that is, it does not contain substances such as prothrombin which are also lost or depleted in shock (174). Zamecnik (198) has shown that in dogs with hemorrhagic shock which are treated with albumin there is a marked fall in the prothrombin concentration, whereas no such fall occurs if whole blood or plasma are used. Janeway and associates have reported a marked fall in the plasma globulin in a burn patient who received large quantities of albumin intravenouly. Additional saline solution and water must be given to patients receiving albumin to replace the interstitial fluid which is drawn into the vascular system by the osmotic action of the albumin.

3. Electrolyte. Saline solution has long been used in the treatment of shock. There is evidence that if it is given intravenously at rapid or moderate rates of injection the blood pressure of the

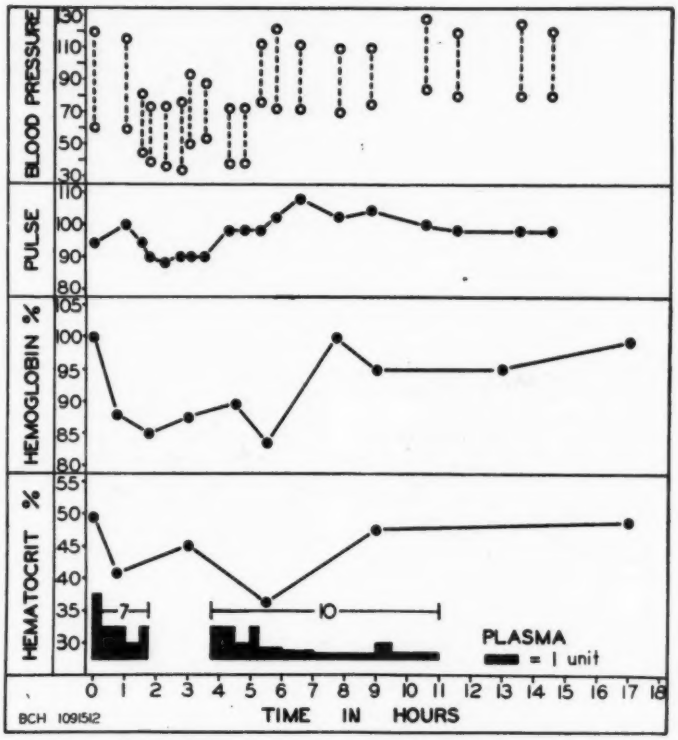


Chart 3. Effect of débridement on rate of fluid loss in a patient with an extensive burn.

shocked individual may be raised, but the effect is frequently transient. In addition, it appears that plasma protein may be "washed out" by the saline solution (21). For these reasons saline solution was replaced by plasma or serum in most clinics when these solutions became available, as they did quite generally in the United States, Great Britain, and Canada between 1940 and 1942. Interest in the use of saline solution alone or in conjunction with other sodium salts has recently again been aroused by the reports of Rosenthal and of Fox. Rosenthal, experimenting on mice with standardized burns, has shown that the effects of sodium salts given intraperitoneally or by mouth very soon after the burn are slightly but significantly superior to the effects of serum given intravenously in preventing death of the animals within 48 hours. In his series the effect of the serum appeared to be due, not to the contained protein, but to the sodium. He also showed that the therapeutic effect of the sodium salt was due to the sodium radical rather than the acid radical since different sodium salts acted in the same manner. Potassium salts increased the mortality. Saline solution when given intravenously was not as effective as when given by mouth. Isotonic saline solution was more effective than the hypertonic solution. Prinzmetal *et al.* have also reported good results in mice with sodium therapy. Fox treated a number of severely burned patients by the oral administration of sodium lactate or sodium bicarbonate, and saline solution. He gave from 10 to 15 per cent of the body weight of isotonic sodium salts in the first 24 hours. Any vomiting, such as occurs frequently in patients with severe burns, was treated by the administration of more oral fluid. The results appeared to be good. It must be stressed that in the studies reported the sodium was used chiefly for prophylaxis and not for treatment of fully developed shock. In addition, dangerously low plasma protein levels were seen in some of the patients.

This work needs careful consideration. For the moment it would appear that while it is true that there is a deficit of sodium in the burned patient, it is also true that there is a deficit of other substances and, although it undoubtedly is necessary to replace the sodium, it is also necessary to replace the other substances. It appears to us that sodium salts are necessary adjuncts to the treatment of burn shock, not the sole therapeutic agents. The work of Moyer *et al.* and Abbott *et al.* on the use of sodium chloride and sodium bicarbonate solutions with whole blood, which will be described in the section on whole blood, are of interest in this regard.

4. Whole blood. Whole blood was used extensively to treat burn shock until 1940. Then plasma and serum became generally available in large quantities and almost entirely replaced it. Among other reasons, it was widely believed that additional red blood cells could serve no useful purpose when the blood was already concentrated. However, during the last 2 years, interest in whole blood has revived, principally because of the work of Moyer *et al.* They studied the therapeutic effects of various solutions on the shock of severe, deep burns of dogs. The dogs were shaved and two-thirds of their surface areas were scalded for 30 seconds by water at 85° C. A combination of transfusions of defibrinated blood and gavage of normal saline solution with added sodium bicarbonate solution was the only form of treatment that prevented shock without inducing such complications as cerebral and pulmonary edema incompatible with life. The unsuccessful forms of treatment were: (1) intravenous administration of saline and bicarbonate solutions; (2) intravenous administration of saline and bicarbonate solutions and dog's serum; (3) intravenous administration of dog's serum with saline and bicarbonate solution by gavage; and (4) intravenous administration of defibrinated blood with water given orally ad libitum. Abbott and his associates have found that whole blood transfusions given during the first day of the burn not only aid in preventing shock in human beings, but also alleviate or prevent the subsequent anemia that frequently appears about the third day after plasma has been used. Levenson *et al.* (115) and Evans and Bigger have also treated burn shock successfully with whole blood in a small series of carefully studied patients.

5. Glucose. The early increased blood sugar in severe burns might be considered to contraindicate the administration of glucose intravenously. However, Taylor and associates (176) have demonstrated that there is no impairment of glucose tolerance or loss of excessive amounts of glucose in the urine under these conditions. In addition, burns cause depletion of the muscle glycogen and possibly of the liver glycogen so that efforts should be made to restore glycogen to these tissues by an adequate administration of carbohydrate. Finally, as mentioned previously, there is an early increase in the nitrogen catabolism, and glucose in large amount may alleviate this. Glucose should be given in substantial quantities. Harkins *et al.* (91) recommended up to 200 grams in the first 24 hours for severe burns. However, glucose must be considered to play only a minor role among the many substances given to these patients, and to be almost or entirely without value if it is given in pure solution for either prevention or treatment of shock.

6. Gelatin. Degraded solutions of gelatin have been studied as plasma substitutes in the therapy of burn shock in dogs (147), and the consensus of opinion is that properly prepared gelatin solutions are as effective in the acute phase, from the points of view of osmotic properties and mortality, as plasma. Koop (108) has come to the same conclusion in working with human patients. However, plasma possesses a number of properties beyond the osmotic characteristics shared by gelatin, and since there are other losses from the blood beyond the loss of osmotic properties it would appear that plasma would offer some advantages.

7. Gum acacia solution. Although interest in this solution was shown by several investigators up to 1940, its use has completely stopped with the advent of human plasma and serum. Not only have these substances been found to be better, but, also, acacia has been found to be harmful when given in repeated doses (82).

8. Oxygen. The defenses of the body against shock and the efforts to maintain blood volume are all in reality attempts to achieve one goal, the maintenance of normal cellular metabolism which is dependent upon adequate oxygenation of the tissues. As indicated previously, tissue anoxia results from the failure of the peripheral circulation. There is no experimental evidence that inhalation of 100 per cent oxygen alleviates the tissue anoxia accompanying shock. Oxygen has been widely used clinically in the treatment of burn shock, but the only clear indication for it is complication of the burn shock by respiratory tract injury.

9. Position. The indications for raising the foot of the bed or placing the patient in the Trendelenburg position are not as clear in the treatment of shock from thermal burns as in the

treatment of simple syncope, since in the burned patient there is no pooling of blood comparable to that in simple syncope. In the burned patient the fluid is lost externally or into the subcutaneous tissue, and it cannot be readily returned to the vascular tree by change in position. However, it appears that the circulation to the brain is improved by tilting the bed, even though the blood volume may not be materially altered. It is especially important to raise the foot of the bed during the first few minutes after the onset of shock while other more effective methods of treatment are being started.

10. External temperature. Because many patients in shock are cold it has been customary to cover them with many blankets and also to use hot water bottles or other sources of heat. Blalock has shown that overheating is detrimental to the animal in traumatic shock, and Elman and associates (61) have shown that both heating and cooling are harmful to burned animals. As already mentioned, occasional patients have markedly high fevers from 18 to 24 hours after a burn. It is important that for patients in shock with a rectal temperature below 34.0 degrees C. or above 40.0 degrees C. very active measures be taken to warm or cool them promptly, but these measures must be stopped as the temperature approaches normal.

11. Sedation in shock. As recently as 1942 it was customary to treat burns with very large doses of opiates. Beecher has shown that this is not a safe procedure when shock is present. He points out that morphine is contraindicated in the treatment of fear or hysteria, or of any condition in the presence of anoxia. It should be given only to relieve pain. Most importantly, he calls attention to the fact that no drug is readily absorbed from the tissues if administered subcutaneously or intramuscularly to a patient in shock. He presents the history of a patient in burn shock who was given repeated doses of morphine subcutaneously without effect. As soon as her circulation was effectively restored by treatment with plasma the whole amount of the drug was taken rapidly into the blood stream and gave the usual effects of an overdose of morphine. Energetic measures were needed to combat these effects. Therefore, when opiates are indicated in patients with shock they must be given intravenously.

Another aspect of this problem has been studied by Elman (61), who showed that the mortality of burned dogs was increased when usual doses of morphine or of barbiturates were given. In view of these findings, morphine and other sedatives should be used cautiously in patients with incipient or actual burn shock. Anesthetics have the same harmful effects, and are very dangerous in incipient or actual burn shock. Cyclopropane is safest if one is necessary (21), but Levenson and his associates have found no occasion to use anesthesia at the time of the first dressing in their most recent 500 cases seen during the last 2 years.

12. Pressor drugs. Frank and his associates have recently studied the therapeutic effects of various pressor drugs in "irreversible" hemorrhagic shock in dogs. They found no indication of beneficial results from the use of pitressin with or without ergotamine, paredrine, coramine, or tuamine. Earlier work by Cannon (30) indicated that the capillary blood flow may be actually lowered when such drugs are used. No such studies have been made on burn shock, but by analogy these studies indicate that these drugs would be of no value.

13. Adrenocortical extract. As described in the section on pathology, there is evidence of adrenal injury following burns. In addition, there is laboratory evidence of increased outputs of adrenalin (159) and of various corticosteroids (24, 47). Rhoads, Wolff, and Lee (157) reported promising results from the use of adrenocortical extract in the treatment of burn shock. A more recent report by the same authors reverses this opinion (158). The later clinical observations were corroborated by the experimental studies of Rosenthal, who found that in standardized burns in mice there is no protective action produced by either desoxycorticosterone or adrenocortical extract injected subcutaneously, when compared with controls injected with saline solution. Lowdon *et al.* had previously reported failure to decrease the mortality of burned animals by the use of desoxycorticosterone. Cope and Moore (45) have demonstrated in dogs that adrenocortical extract has no influence on the abnormal permeability of the capillaries in the burned area. In view of the failures encountered, there is no indication at present for its use in the early postburn period.

14. Vitamins. Govier, working on hemorrhagic shock in dogs, has indicated that B complex vitamins, particularly thiamin, have a definite therapeutic effect on the shock. In addition to their findings mentioned previously on the effect of burns on vitamins, Lund, Johnson, Taylor, and associates (126) have found great depletion of water soluble vitamins during the shock phase of burns. They believe it is logical to administer large doses of these vitamins early after admission of the patient.

15. Anesthesia and surface treatment. The very serious effects that these items may have on burn shock will be discussed in the subsequent section on surface treatment.

RESPIRATORY COMPLICATIONS

Injury of the respiratory tract is an important complication of a few thermal burns. It should be suspected in any patient who gives a story of having inhaled large amounts of hot smoke, particularly if consciousness has been lost. Patients with injury of the respiratory tract usually have burns of the face, but this condition may be seen in patients with no external burns (68). Singeing of the fibrissae of the nares, soot on the face, and burns of the nasopharynx are commonly seen in these cases. As described in the section on pathology, the fundamental lesion is a necrotizing tracheobronchitis. Finland *et al.* found the usual symptoms to be cough, hoarseness, dyspnea, and stridor. The sputum was mucoid, purulent, and bloody. Occasionally casts of trachea and bronchi, resulting from pseudomembrane formation, were coughed up. The vital capacity was greatly diminished. Physical examination revealed scattered areas of dullness, hyper-resonance, and rales of all varieties, but chiefly crepitant or fine wheezes. X-rays showed scattered small areas of emphysema, atelectasis, and congestion. Secondary pneumonia, chiefly due to the staphylococcus aureus, was seen in some patients.

Any patient in whom injury of the respiratory tract is suspected must be watched very closely. A tracheotomy kit should be kept at the patient's bedside. Respirations should be charted every half hour. Examination of the nose, nasopharynx, epiglottis, larynx, and vocal cords should be made. If burns of the nasopharynx are present, swabbing the nose with bland oil and having the patient gargle with a warm soothing solution, such as glucose in water, will be helpful.

If cough or dyspnea develops, the air should be humidified. If these symptoms progress in spite of humidification, the patient should be placed in an oxygen tent. Inhalations of 10 per cent carbon dioxide and 90 per cent oxygen should be given for a few minutes every one to two hours to induce deep respirations. The patient should be moved frequently and encouraged to cough. If there is any wheezing or other signs of bronchial spasm, aminophyllin or adrenalin should be given intravenously, or adrenalin should be given by nebulizer. Generalized laryngobronchial spasm may occur very suddenly and may lead to death of the patient unless it is relieved immediately. Tracheotomy with artificial respiration may be necessary. Tracheotomy is also indicated if stridor, air hunger, or other signs of laryngeal obstruction appear. Suction through the tracheotomy tube should be done repeatedly as needed. When simple aspiration through the tracheotomy fails, bronchoscopic aspiration may succeed.

A dose of 25,000 units of penicillin should be given intramuscularly on entry and repeated every 3 hours. If the urine output is good, sulfadiazine may also be given. If the patient is restless, one must first rule out anoxia, and, if present, steps such as have been described should be taken to provide for oxygenation. For restlessness due to pain, meperidine hydrochloride should be used rather than morphine or any other respiratory depressant. For restlessness due to nervousness or anxiety, the barbiturates should be used (14).

If the patient with injury of the respiratory tract has extensive surface burns in addition, plasma should be given without hesitation to prevent or treat shock. Finland found no evidence to indicate that plasma infusions under such circumstances led to pulmonary edema. Plasma may also, very rarely, be indicated in the patient with respiratory burns who has no external burns.

INFECTION IN BURNS

Infection is always a serious complication of extensive deep burns, and frequently or rarely, according to the efficacy of treatment, a complication of lesser burns. Its control is, therefore, one of the most important aims of therapy.

A. Initial contamination. A burn immediately after the accident harbors few pathogenic organisms since the process of burning sterilizes the skin in the affected area. However, unless protected, the lesion is rapidly contaminated. Great sources of serious contamination are the respiratory secretions of individuals handling the patient (33). Also important are the materials which come in contact with the burn and the bacteria that may remain viable in the deep crypts and ducts of the skin in the burned area, or in the skin of adjacent areas.

B. Bacteriology. In careful bacteriological studies of burns in patients cared for in a special ward at the Royal Infirmary at Glasgow, Clark (33) found that the hemolytic streptococcus was the predominant infecting organism. This corroborated the previous studies of Aldrich in 1933 at the Johns Hopkins and the Boston City Hospitals. However, most of the studies that have been carried on during the last 4 years at many widely separated civilian hospitals in the United States have shown that hemolytic streptococcal infec-

tions in burns are infrequent (135, 117). They show that burns at all stages are almost always contaminated or infected with several organisms. Aerobic, anerobic, gram positive, and gram negative bacteria, and cocci may all be found in any single culture. The number of varieties of bacteria found is usually related to the care and variety of the culture methods employed. Serial cultures taken from a single burned area show changes from time to time in the variety and proportions of the different organisms. They also show that the hemolytic staphylococcus is the predominant pathogenic organism. Almost every culture at any stage of the many burns studied by Meleney (135), Lyons, and Levenson (117) have shown it to be present. It has not been eliminated by sulfonamide or penicillin as given to date. Fortunately, its mere presence does not prevent successful grafting (117). When the hemolytic streptococcus is predominant, however, it does interfere with successful grafting in many cases. Fortunately, it may be eliminated by the use of large doses of penicillin (113) or of sulfonamides (3). Acute hemolytic streptococcus infection of the burn with the rash of "scarlet fever" occurs occasionally in children. It responds well to chemotherapy.

Symbiotic infections in which an anaerobic or microaerophilic streptococcus is associated with one or more other organisms occur rarely (135). Under these conditions there may be burrowing of the infection at the edge of the wound and destruction of otherwise viable dermal tissue.

An unexpected finding of Meleney's study was the frequency with which anaerobic organisms were observed. However, there was essentially no clinical infection with the bacillus welchii or other clostridia except the bacillus tetani. It must not be forgotten that clinical tetanus is occasionally seen in burns and that tetanus antitoxin should be given prophylactically to all patients with deep burns.

The more frequently encountered bacteria are listed in Table III in approximate order of their importance.

TABLE III—VARIETIES OF BACTERIA FOUND COMMONLY IN CULTURES FROM BURNS

Staphylococcus hemolyticus, coagulase positive
Streptococcus hemolyticus, (beta and gamma)
Bacillus proteus
Bacillus pyocyaneous
Bacillus coli
Diphtheroids
Other staphylococci
Other streptococci
Other enterococci
Pneumococci
Bacillus mucosus capsulatus
Bacillus welchii
Bacillus tetani
Other clostridia

The skin in dermal burns retains most of the resistance that normal skin has against infection. If rest and avoidance of recontamination are provided, any organisms growing on the surface soon die out as healing progresses (42). With deep burns the problem of infection is much more serious because deep burns are always infected from a few hours after the burn until healing is complete. During the first 2 to 6 weeks necrotic slough is present on the surface and it furnishes an excellent medium for bacterial growth. After the slough has separated, the open granulating wound continues to harbor bacteria as long as the wound is open. The question of control of infection by local and general measures will be considered later.

HYPERPYREXIA IN BURNS

Patients with burns frequently have a period of high fever (over 41 degrees C.) in the first few days after the burn. This is observed in adults only if they are burned extensively, but in children, and particularly infants, it may occur as a complication of small area burns. The occurrence of delirium, stupor, convulsions, or coma should suggest the possibility of hyperpyrexia. The oral temperature may frequently be misleadingly low, and rectal temperatures should be taken of all such patients. Infants in particular should have hourly rectal temperatures taken during the first 24 hours, and 2 hourly temperatures during the next 24 hours. The pathogenesis of this early high fever is not known. It does not appear to be due to infection since in most instances there are no signs of spreading infection, either at the time of the fever or later. Pyrogens in intravenous fluids are responsible only occasionally. Shock and dehydration may play a role, but in many cases high fever is seen in the absence of these factors. Increased heat production due to the increase in metabolism as a result of extensive burns together with, and more important, the decreased ability of the patient to lose heat because of the greatly restricted area of exposed normal skin may be important. Walker and Shenken believe that in many cases the fever is cerebral in origin.

The burn patient cannot tolerate a high fever, so that if the rectal temperature remains above 41 degrees C. for more than a very few hours death is almost certain. Prompt and energetic treatment directed toward cooling the patient is effective in many instances and this treatment should be started whenever the rectal temperature is above 40 degrees C. If the fluids given have

been inadequate, more fluid will help, but the main attention should be directed to ice water sponge baths to all exposed skin. If less than 50 per cent of the skin is exposed it may be necessary to remove some of the dressings. Windows should be opened, drafts created, bed clothes removed, and an ice water bath made in the patient's bed. He should be sponged for ½ hour or more until the rectal temperature is brought to 39 degrees C., but not below this.

PRIMARY LOCAL TREATMENT

A. Introduction.

During the decade from 1930 to 1939, tannic acid, tannic acid and silver nitrate, gentian violet, and "triple dye"[1] displaced to a large extent all former methods of primary surface treatment of burns in the United States and Great Britain and its Dominions. From 1937 to date other forms of treatment have been advocated strongly and have now replaced the tanning methods as completely as the tanning methods replaced the older methods a few years earlier.

All methods of treatment of burns have always been based on an attempt to correct some one or more deleterious effects of the burn. Tannic acid was introduced to reduce the external fluid loss and to fix postulated toxins in the skin. The dyes were introduced to accomplish the same results and to furnish also an antiseptic action. In 1937 Allen and Koch introduced the now well known pressure dressing. They claimed that the pressure reduced both internal and external fluid loss and that infection was reduced by careful initial cleansing and by the rest and protection furnished by the bulky dressing. Originally no antiseptic except boric acid ointment was used.

With the introduction of the sulfonamides into medicine, they were immediately introduced into the treatment of burns. Pickrell used a solution containing sulfanilamide that was sprayed on to form a transparent eschar. Others used various sulfonamide ointments, or merely dusted on the drug and covered it with petrolatum or a bland ointment. Gurd combined the cleaning and pressure method of Allen and Koch with a sulfathiazole "cream." Others used preformed films containing sulfonamides (6). Whether or not sulfonamides were used on the surface they were also given by mouth or parenterally. New antibacterial agents, such as propamidine, were discovered and used. Finally, with the discovery and production of penicillin, it was used locally and parenterally. In order to secure more complete rest and more even pressure, plaster casts were introduced to replace pressure dressings in some cases. Recently the washing of burns was given up by Cope (43), and washing, ointments of all kinds, and routine chemotherapy were given up by Levenson and Lund (117). Complete excision of small area burns on entry with immediate skin grafting has been carried out successfully. Delayed excision and skin grafting of more extensive burns have been used by Cope and Moore (46). Chemical excision of the burn with early skin graft was successful in serious cases (39).

There is still no general agreement as to primary local treatment. Recently, however, certain fundamental conceptions have been widely accepted and have led to a more nearly unified view of treatment. The first of these is that the care of local areas in a patient with burns of any important size is but part of the total treatment of the patient. The second is that the treatment of the patient should be based on methods to correct as far as possible the many physiological and pathological changes brought about by the burn. Local plasma loss should be limited, further contamination prevented, and infection controlled. Any surface application should cause no local or general toxic effects. Application of the treatment should be rapid and relatively easy and the least possible attention should be required thereafter. It should be stressed, however, that no fixed routine can be established for all cases. An understanding of the underlying principles will make it clear when variation in methods should occur.

B. Fluid loss.

In addition to the harm done by the loss of fluid from the circulation by causing shock, the fluid is harmful to the subcutaneous tissues because it clots there and increases the extracellular pressure with resulting increased fibrous tissue (75). This results in subsequent impairment of function. This is evident particularly in burns of the hands in which it is often seen that following some dermal or deep dermal burns there is marked limitation of motion of the fingers. On review of these cases it is found that swelling occurs early and persists for some time. In contrast, it is found that in cases of similar severity in which minimal swelling has been prevented, function is unimpaired (74, 12). It is apparent, therefore, that from the point of view of both local and systemic reactions, one of the features to be desired of any local treatment is that it limit the amount of internal and external fluid loss.

[1] The formulas used under this name vary. One is:

Gentian violet	1.0
Brilliant green	1.0
Acriflavin	0.25
Distilled water, ad	100

1. Washing of burns. Washing of the burned area opens up previously closed tissue spaces and leads to a considerable increase in fluid loss, as was pointed out in the discussion of Chart 3. The relation of washing to infection will be discussed later.

2. Escharotics and pressure dressings and casts. Tannic acid and other escharotics until recently have been widely employed for primary treatment, in part because of their ability to prevent external exudation of fluid from the burned area. There is no doubt so far as the tannic acid and silver nitrate combination, with its rapidly forming eschar, is concerned, that this end is accomplished. While the use of tannic acid is not desirable because of its toxic action on the liver, nevertheless the necessity of prevention of external losses of fluid in occasional dermal burns may be judged from the following experience:

The patient was a 22 month old child weighing approximately 15 kilograms, who was admitted to the hospital with hot water scalds involving 25 per cent of his body surface. The burned areas were oozing plasma at a rapid rate. There was very little subcutaneous edema. The surface was treated by the application of petrolatum and pressure bandages. The external loss of plasma was not arrested and the bandages continued to be soaked with fluid for at least 36 hours. During this time 8 units (2,000 c.c.) of plasma were administered with no hemodilution. This amount of plasma represented approximately three times the plasma volume of the child. In spite of this, shock occurred three times in the first day. Had it been possible to prevent the enormous surface loss this very large amount of plasma would not have been required.

It has been our experience that pressure dressings, or casts, applied over ointment, have very little effect on the amount of fluid lost externally, while the agents which rapidly form eschars do stop surface leakage. However, treatments aimed at sealing off the burned surface do not and cannot prevent the loss into the subcutaneous tissues. As pointed out by Underhill, Harkins (87), and more recently by Glenn and his colleagues (75), this subcutaneous loss in deep dermal and deep burns is considerable and may surpass the external loss. The latter state that in one of their dogs with burns of the two front feet, plasma equivalent to more than one-third of the animal's blood volume passed into the area from the toenails to the humeroradioulnar joints.

An example of the failure of tannic acid to prevent internal fluid loss may be derived from a re-examination of Chart 2. Shortly after admission the patient was treated with tannic acid and silver nitrate solutions. Fifteen minutes after such treatment the external extravasation of fluid from the burned areas ceased completely and yet the rising hematocrit and hemoglobin showed that fluid loss continued for many hours. As a matter of fact the presence of increasing subcutaneous edema was easily discernible on physical examination. This subcutaneous loss of fluid has been minimized experimentally in dogs (74), and clinically, in human beings, by the use of close fitting plaster casts (12, 116) and elastic pressure dressings (5).

C. Local tissue injury caused by surface treatment.

It is desirable that no further injury be imposed on the burned area by the agent used in the local treatment. It has been shown that the escharotics, as opposed to bland ointments, injure viable epithelium. Partial thickness donor sites heal significantly faster under a firm ointment dressing than under tannic acid and silver nitrate, or triple dye (29, 97). Healing of dermal burns of the back takes place a few days earlier if ointment is used rather than either tannic acid and silver nitrate or triple dye (36). Epithelization under a dry gauze pressure (113) or saline pressure (143) dressing proceeds at the same rate as under a petrolatum dressing.

D. Systemic effects of substances applied locally to the burned area.

Absorption of certain types of substances from the surface of both second and third degree burns has been demonstrated (132). Therefore, it is important that any agent used in the treatment of the burned area either be not absorbed, or, if absorbed, be relatively nontoxic. This is especially important when burns of a large area are being treated. Jaundice and other evidences of liver damage are seen more frequently in patients treated with tannic acid than in those treated with bland ointments (93).

Boric acid ointment has been used often in the local treatment of burns. Boric acid has no particular virtues and since it may be absorbed in toxic amounts if applied over a large area of injured skin (150) it had best be avoided and simple petrolatum used.

Sulfonamides in soluble form, if used locally, may be absorbed in toxic amounts (120). Therefore, if used, the preparation should remain in effective concentration locally and yet not be absorbed rapidly enough to cause general systemic reactions. Since there is often early oliguria in severely burned individuals, the possibility of

kidney damage secondary to the sulfonamides is increased. A 5 per cent sulfathiazole emulsion from which the absorption is relatively slow has been used with good results (80).

E. Prevention of infection.

Strict aseptic technique in the handling of burned patients is necessary to prevent additional contamination of the wound.

1. Washing and débridement of burns. Until recently the custom of washing and débriding burns had not been challenged. The characteristic view was that expressed in the following quotation: "To cover a burned area with chemical or coagulating solutions without first using every effort to transform it into a clean wound seems to us inexcusable disregard of fundamental surgical principles" (5). However, it should be borne in mind that a burn is different from the ordinary soft tissue wound: initial contamination is slight and it is rare that subcutaneous tissue and muscle are exposed. The type of débridement practiced in the primary care of soft tissue wounds cannot be carried out in any except very small burns. Even simple washing of a burn has certain disadvantages—the increase in time, fluid loss, handling, and pain—which make it preferable to omit washing if possible. Routine washing of burns has recently been shown not to be necessary if pressure dressings or casts are used (43, 116). However, it is generally agreed by those who do wash burns that it should be done gently and quickly. White soap has been most commonly used rather than tincture of green soap.

2. Prevention of further contamination. It is essential that the area be protected from further contamination. When escharotics are applied, the eschar, which is at first intact, soon cracks and further contamination is thereby possible. Pressure dressings or casts which remain dry on the outside prevent the entrance of additional organisms. If, however, the dressing becomes saturated with exudate, contamination is possible. This has been minimized by the incorporation of a cellophane membrane in the dressing (143).

At each dressing change there is the possibility of further contamination. Consequently, dressings should be done at infrequent intervals. The first dressing should remain in place for about 2 weeks. At the end of this time most dermal burns are healed and require no further dressing, but deep dermal, mixed, and deep burns are just beginning to slough so that additional dressings are required.

3. Immobilization. The importance of immobilization in the control of infection has been amply demonstrated. The absorption of toxic products, metabolic or bacterial, depends to a large extent on the lymphatic flow which is reduced considerably by rest of the injured part (12). In contrast to surface eschars, pressure dressings with splints or close fitting casts provide for immobilization of the burned area.

4. Chemotherapeutic agents. These agents have been widely used for the control of infection of burns. The sulfonamides have been used both locally and systemically, but their efficacy in controlling the local infection of the burn has not been clearly demonstrated. When one considers that there is usually a mixture of gram positive and gram negative organisms in the burned area, and, in addition, there is present considerable necrotic tissue and exudate, it is not surprising that there is no striking control by the sulfonamides. In some instances it has been claimed that while the local infection is not controlled, spreading infection and blood stream invasion are prevented (135).

It must also be remembered that all deep burns will have an open wound harboring organisms until the last grafts have successfully healed and that this may take several months. As it is unlikely that any patient can tolerate effective doses of any sulfonamide for this length of time, it is recommended that no general sulfonamide treatment be given as a prophylactic measure or for any other purpose except for some complication such as pneumonia.

Penicillin has been used locally and systemically in many cases of serious burns (117, 96, 191, 22). When used locally it has the great defect of rapid absorption from the wound. To overcome this objection experiments are being made with special ointment bases such as carbowax[1] (136). With such a base some penicillin activity may be maintained for as long as 24 hours. A more serious defect is the rapid destruction of penicillin by the action of penicillinases released by bacteria, such as the colon bacillus, that are present in the wound and which are not sensitive to its action. When given intramuscularly, penicillin has not been shown to reduce in any way the hemolytic staphylococcus infection of a burn. Possibly if such an infection were found in pure culture on a burn it might be effective for this purpose, but such pure cultures are seldom seen. Hirshfeld (96) stated that when penicillin was used before and after skin grafting better results were obtained. Levenson and Lund (117) found that it was possible that the change of

[1]Carbowax is the name of a series of polyhydric glycols. They are water soluble but have the consistency of greases.

technique of dressing in the preparation for grafting associated with the use of penicillin was more important than the drug. On the other hand, in the few cases in which the cultures from a granulating wound that is ready for grafting in every other way show repeatedly that the hemolytic streptococcus is the only or predominant organism, general penicillin should be used in the dose of 25,000 units every 2 hours for 48 hours before and after the graft. Under this special condition it has been shown to be very useful.

F. Technique of application of a pressure dressing.

Under operating room conditions fine meshed gauze, dry or impregnated with petrolatum, should be applied directly to the wound. Over this, sufficient sterile gauze, absorbent cotton, cellucotton, or mechanics' waste should be placed so that even compression can be secured by means of a firm, wide bandage. If the padding is furnished in large rolls of material from 1 to 2 centimeters thick, 20 centimeters wide, and 4 meters long, it facilitates the application. It should be emphasized that to be maximally effective the dressing should be applied as soon as permitted by the general condition of the patient, since the greatest amount of swelling occurs in the first few hours following injury. Also, since the swelling is not limited to the burned areas, but occurs also in the immediately adjacent areas, these areas must be incorporated in the dressing. In burns of the extremities the dressing must extend distally to cover completely the hand and foot, even if these areas are not burned, otherwise the venous return will be obstructed, and as the back pressure builds up, the arterial blood supply will be impaired. Elevation of the extremity may help to prevent stasis and discomfort. In applying a pressure dressing the tension must be uniform, and care must be taken that no more pressure is used than is required. In burns of the chest and abdomen a pressure dressing, as such, cannot be applied without interfering with the patient's respiration. Therefore, in this location a firm bulky dressing without pressure is used.

G. Technique of application of close fitting casts.

The application of close fitting plaster-of-Paris casts is recommended for burns of the extremities, particularly for burns of the hands, but it is not recommended for burns of the trunk, buttocks, or head. Under operating room conditions, one layer of sterile fine meshed gauze, dry, is applied to the entire area to be covered by plaster. This is covered with four layers of sterile open mesh gauze, fitted carefully without overlapping. Plaster slabs are then molded over the extremity, front and back. A thin layer of rolled plaster completes a nearly skintight, light, well fitting plaster cast. The cast must be close fitting, but must be applied without compression at any point. As in the case of a pressure dressing, it should extend proximally from 7 to 16 centimeters beyond the limit of the burn. In burns of the extremities it must extend distally to cover completely the hand and foot (including the tips of the fingers and toes) even if these areas are not burned; otherwise the circulation will be seriously impaired. Hands should be put up in the position of function with a slight cock-up at the wrist and fingers in neutral position. It is all important that directions be followed exactly (12, 116). Levenson and Lund have seen instances in which improperly made casts had to be removed to prevent gangrene.

H. The use and technique of petrolatum gauze dressings.

Allen and Koch, Cope (42), and others advise pressure dressings for burns of the face, head, and neck, as well as for those of the trunk and extremities. After using them on a number of patients Levenson and associates (113) have given them up in treating these particular burns. Two reasons led to this decision. First, such dressings were always uncomfortable when used for serious burns. Second, sufficient pressure could not be used to control the edema of the face or neck. They now use sterile petrolatum gauze strips applied without pressure and without bandage. These strips rub off from time to time and new ones are put on by a nurse. They are rectangular and approximately 8 by 16 centimeters. They are made of fine mesh cotton bandage material impregnated with petrolatum and sterilized. Other areas where pressure dressings are impractical are the genitalia and the anus. Petrolatum strips are also used there.

When this treatment is used, the hazard of contamination is increased. However, this hazard is great in burns of these areas with any known treatment. It may be reduced by isolating the patient, by using sterile bed clothes, and by careful aseptic nursing procedures.

SECONDARY SURFACE TREATMENTS

The first pressure dressing or cast should be left in place for 2 or 3 weeks except in the few very superficial dermal burns that have probably healed prior to this time. A foul odor, contamination of the dressing by urine or feces, and evidence of infection under the dressing, should rarely be

considered indications for a change at any earlier time. If the dressing becomes loose or slips it should be repaired by adding more sterile material, new outside bandages, and new adhesive.

Changes of dressing should be made under aseptic conditions in an operating room. The patient should usually be prepared by a mild sedative. Anesthesia may be needed in rare, severe, chronic cases at many late dressings. Cyclopropane is the anesthetic agent of choice. On removal of the dressing, the status of the wound is appraised and the further needs of the patient are estimated. Dermal burns will usually be healed in 2 weeks, but deep dermal, mixed, and deep burns will be covered with soft, foul slough. Purulent material and loose slough may be wiped off gently, but no antiseptic solution should be used. In these cases some remaining slough will be present from 20 to 40 days. The second and all subsequent dressings should also be pressure dressings applied with the same technique described. As soon as large areas have become free of slough, and if the granulations and the patient are both in good condition, grafts should be applied without waiting for the adjacent slough to separate. In addition to the "chemical débridement" which will be described, many varieties of dressings have been suggested to speed the separation of the slough as well as to control infection. In general, every method, and this includes the one recommended here, has disadvantages as well as advantages. Frequent changes of dressings, wet, dry, or with ointments, traumatize the wound and increase the danger of bacterial contamination, and the process of changing them is wearing to the patient. Antiseptic solutions or ointments may injure the granulations, the patient, or both, and never eradicate infection. Pressure dressings applied to several extremities produce such immobility of the patient that he loses strength rapidly. On the other hand, less confining dressings fail to control the pain from friction and allow more contamination. Both are weakening.

Tub baths and shower baths have been recommended (137). In general these are difficult to arrange and are infrequently used at present in the United States. A good method of providing continuous or intermittent irrigation with saline or Dakin's solution of the extremities has been devised by Bunyan. He uses a transparent plastic envelope that has two rubber tubes sealed into its sides. It is troublesome to use.

During the last 2 years Levenson and associates (113) have abandoned all previous forms of secondary treatment and apply infrequently changed dry pressure dressings or casts to the extremities and similar nonpressure dressings to the trunk. Even the use of frequently changed wet dressings just prior to grafting has been discarded (117). The only exception to this treatment of these areas is when very small scattered areas of granulation are left at the edges of the grafts. Under these conditions nonpressure frequently changed petrolatum dressings are used.

SKIN GRAFTING

Until the advent of the Padgett dermatome the technique of skin grafting burns of large area was difficult and was mastered by few surgeons. The simplest technique, but least satisfactory, is that of Reverdin. Somewhat more difficult, but more satisfactory, is that of Thiersch and much more difficult, but most satisfactory if successful, are the whole thickness graft and the pedicle graft. There is a great tendency, particularly among surgeons who treat burns only occasionally, to wait many months before doing any graft to allow nature to make its maximum efforts at healing. With such a laissez-faire policy, burns adjacent to the joints lead to crippling contractures and deformities.

If Reverdin grafts are used early, placed closely, and take, they will grow out, cover large areas and, at least in part, avoid contractures. However, the skin surfaces (both recipient and donor) are always "spotty" and seldom satisfactory. Expertly cut Thiersch grafts stretched to normal tension and completely covering a noncontracted granulating surface are much more satisfactory. In fact, the grafted skin approaches normal skin in appearance and function, and the donor site often becomes invisible.

Whole thickness grafts are of very little importance in the treatment of large burned areas. For small specialized areas, such as the eyelids, face, and neck, they are essential, but the care of such defects is in the field of much more specialized plastic surgery than is within the scope of this review. The same is true of pedicled grafts.

A. Immediate excision and skin grafting.

Immediate excision and skin grafting has been carried out by several authors (197). It is theoretically sound because after a deep burn is excised and the wound grafted, the area is healed in a week or 10 days. However, it has a very limited applicability and is indicated only in obviously deep burns of very small area in which there is little likelihood of shock. Relatively few deep burns come in this category. Even with a small burned area the operation is a long one be-

cause of the difficulty of securing complete hemostasis.

B. Delayed excision and skin grafting.

Delayed excision and skin grafting has been carried out recently in a number of cases by Cope and Moore (46). It is their practice to give large amounts of penicillin intramuscularly and locally through Dakin's tubes incorporated into a pressure dressing at the time of burn. From 3 to 7 days later, when the shock has been satisfactorily treated and the general condition of the patient is good, the burned area is excised and grafted at one operation, or grafted later within a few days. If the area is very extensive, the procedure must be done in stages. The same procedure, begun at a later date, between the tenth and fourteenth days, has been followed by Ackman and his associates (3). In their technique no parenteral chemotherapy is given but a sulfathiazole emulsion is used locally. The results of these procedures have been excellent, and the method has great promise in the hands of surgical teams experienced in dermatome grafting operations and in the care of surgical shock. Blood transfusions to the amount of several liters may be needed at the time of, and immediately after, these operations.

C. Skin grafting after sloughing.

Burns are grafted in most clinics in the granulating stage. The time when the slough is completely separated is usually between the third and sixth weeks. Sloughs on small and more vascular areas, such as the face, separate more quickly than those on larger and less vascular areas. Recently, attempts have been made to speed up the time of separation of the slough by the application of various solutions such as the proteolytic enzymes, papain (41) or pepsin (100), or by the application of pyruvic acid in a starch paste (39) (chemical débridement). With the latter method the sloughs of deep dermal and deep burns may be removed in from 6 to 10 days without injury to any epithelium that may be present in the more superficial areas, or to the granulation tissue. Some very impressive results of its use in severe burns have been reported.

When the condition of the patient is satisfactory the granulations are firm and pink, and the chances of successful skin grafting are good. When unsatisfactory, the granulations are edematous and friable, and the chances of successful skin grafting are poor. In most cases granulation tissue is not removed. However, exuberant but firm granulations, if removed down to a firm yellow base, are no contraindication to grafting. Bleeding is controlled by warm saline packs, or the application of thrombin (51).

D. Technique of dermatome skin grafting.

The Padgett dermatome (145) has many advantages over the knife or razor for cutting Thiersch grafts. Sheets of even thickness may be cut from parts of the body that could not otherwise be used as donor sites. Any thickness of skin, from 0.15 mm. to full thickness of the skin, may be taken. Grafts should be between 0.15 and 0.30 mm. thick. The amount of skin transferable at one operation is limited by the patient's general condition. Patients should seldom have more than four drums of skin grafted at one operation. Very sick patients can tolerate only two drums.

1. Anesthesia. Although it is possible to cut grafts after infiltration of the skin and subcutaneous tissue with procaine it is much more time consuming and difficult than to cut them under general or spinal anesthesia. Patients with extensive wounds do not tolerate ether, nitrous oxide and oxygen, spinal, or pentothal anesthesias well. Cyclopropane is much safer and is very satisfactory. Levenson and his associates (113) have used it in several hundred operations without any complication.

2. Choice of donor sites. Any part of the trunk, the whole circumference of the thigh or arm, and the posterior surface of the calf may be used as donor sites. Smooth areas on the thighs, chest, abdomen, and back that are not too hollow or too sharply rounded are the areas most easily used. If the patient cannot easily remain prone for a few days, use of the back will cause postoperative discomfort.

3. The operation. Before the patient is anesthetized the dermatome knife should be inserted in its slot with the bevel away from the drum and its edge adjusted to cut the desired thickness of skin. This is done by setting the flange plate at zero and bringing the blade flush with the drum by turning the two adjusting screws at the sides. Then, turning the flange plate the required number of graduations will set the blade at the correct distance from the drum. The flange plate is graduated so that one division equals 0.025 millimeter. While the patient is being anesthetized the donor site is prepared with any standard method of skin preparation. If the wound dressing is removed at this time care must be taken not to contaminate the donor site, the instruments, or the team that will take the graft. After sterilization, the donor site must be washed care-

fully with ether to make the skin absolutely dry. Then the drum is coated with an even thin layer of the special rubber cement that is furnished with the dermatome. Another layer of cement is then put on the dry skin. This is allowed to dry for from 2 to 5 minutes until it has lost its shiny moist appearance. The dermatome is then grasped in the surgeon's left hand with the back of the blade resting on his wrist. The distal edge of the drum is placed on the distal edge of the donor site and pressed down firmly for 1 minute. The edge is then raised about 1½ centimeters by rolling the drum. The blade is then brought into contact with the skin by the right hand. Cutting is accomplished by short quick strokes of the blade while the left hand rolls the drum slowly toward the proximal edge of the donor site. The skin in contact with the knife should be under slight tension by being lifted by the adherent cement, while the skin about 2 centimeters proximal should be compressed by the drum. After from 1 to 2 centimeters have been cut an assistant should inspect the graft to determine its depth. If it is not correct the cut may be made thicker or thinner by moving the flange. This is done without removing either the drum or the blade from their positions. At times it may be necessary for the assistant to press down on the skin just lateral to the drum to keep this skin from interfering with the stroke of the knife or from being cut irregularly. When the proximal edge of the drum is reached the graft should be cut free with a separate scalpel. It is then picked up with small hemostats, peeled off the drum, and laid on a sponge moistened with saline solution. Powdering the upper surface which is sticky from the rubber cement with sulfanilamide will make it much easier to handle. Other grafts are then cut if necessary. After all the grafts to be used are cut, the donor sites are covered with one thickness of fine mesh nylon or rayon and a few layers of gauze and towels to protect them from contamination during the remainder of the operation.

The area to be grafted is then uncovered, the skin around it sterilized and draped, and the wound surface is cleansed by applying moist sponges which are then removed without rubbing. The grafts are then laid on the wound in the largest possible pieces that fit. When the areas to be grafted are small or irregular in shape the grafts should be cut into pieces that fit. Whenever possible, the grafts should come at least to the edges of the wound, and preferably, they should overlap the edges slightly. Unless the method of using a "backed" graft, which will be described, is used, the graft should be stretched to normal skin tension by sutures from 5 to 6 millimeters apart around its edges. A pressure dressing over the graft, which is strapped and bandaged into place so that it cannot possibly slip, is essential. If the graft is on an extremity a plaster cast fixing the joints above and below the area grafted is also important.

The donor sites are now bandaged over the temporary dressing. If the donor site is on the anterior surface of the body, arms, or legs, the whole dressing should be removed down to the single layer of nylon or rayon as soon as the patient is in bed. This should be exposed to the air to allow a dry scab to form which will protect the wound. This should be left in place until it falls off spontaneously after healing has taken place in 2 or 3 weeks.

4. Backing for dermatome grafts (78). The technique just described gives very satisfactory results but is time consuming because in order to stretch the grafts properly it is necessary to use a great many sutures. Usually the suturing is the longest part of the operation. When the grafts must be subdivided it is especially difficult to handle the pieces. Webster has recently shown that plio film[1] may be used as a backing for grafts, and Evans (64) has suggested cellophane for the same purpose.

Before a graft with a backing is cut the drum is coated with dermatome cement and the backing film cemented to the drum as smoothly as possible. New coats of cement are then applied to the film and to the donor site and the graft is cut as described. The graft with its backing is removed from the drum and is placed on the recipient site. The backing prevents the normal contraction of the skin that results from its elasticity and gives it added strength. The handling of the cut skin is consequently much easier and any cutting of pieces to fit small or irregular areas is more easily performed. More important, however, is the fact that no sutures are needed to maintain the graft at its original size and tension. The graft is maintained in place by even elastic pressure provided by a suitable pressure dressing. The backing is easily peeled off after the graft has healed.

Experience with cellophane as a backing material has shown that it is difficult to apply this substance to the dermatome without its wrinkling. Even very small wrinkles cause irregularity in the thickness of the graft. A more serious difficulty is due to the relative "stiffness" of the cellophane and the graft. When attempts are made to fit the cellophane backed graft to sur-

[1]Plio film is the trade name of a smooth plastic film that is relatively pliable.

faces that are convex, concave, or irregular, wrinkling frequently results. This may lead to areas where serum or blood collects beneath the graft because of poor approximation to the granulations and over these areas the graft may be lost.

Fine gauge nylon[1] or similar rayon has proved to be more useful than cellophane. In the first place, it never wrinkles on the dermatome drum. Secondly, it sterilizes as easily as any textile and does not need special packing in the sterilizer to prevent adherence of its adjacent surfaces. It is unchanged physically after sterilization. In spite of its relative limpness before it is attached to the skin, it prevents contraction of the graft and sutures are unnecessary. Grafts backed with nylon conform better to irregular surfaces than do those backed with cellophane. In addition it has been found that it is possible to cut the skin from 0.15 to 0.20 millimeters thick. Such grafts are slightly thinner than those which can be successfully cut and handled without backing. The donor sites from which such thin grafts have been taken heal very rapidly and can be used again in a relatively short time. On all areas where split thickness grafts are satisfactory, grafts of this thickness have given as satisfactory end results as slightly thicker ones.

E. Homografts.

Homografting, or the use of skin from some one other than the burned individual, is in the nature of a temporary dressing, since such grafts disappear in from 3 to 6 weeks. The only permanent homografts have been transplanted from one identical twin to another (23). The blood group as such appears not to have any important bearing on the success or duration of this type of graft. Homografting has a limited, but definite, application in the care of patients, particularly children, with extensive burns. With the granulating areas covered, though only temporarily, the general condition of the individual improves so that by the time the grafts dissolve, autografts may be made. Ackman (2) has had a large series of cases in which these grafts were used successfully.

NUTRITION

As noted in the earlier section on nitrogen metabolism, there are great early losses of nitrogen in the urine and losses from the surface of the burn until epithelization is complete. The fact that low plasma protein levels and hypoproteinemic edema occurred late after burns was noted by several investigators between 1930 and 1940. A fine report on this subject was that of Clavelin and Hugonot. There was very little of practical value that could be done at that time to improve the nutrition of their patient and an amputation had to be performed. When human plasma and serum became available they were used to combat this nutritional edema, and following the attack on Pearl Harbor they had their first large scale clinical trial for this purpose. The results of plasma treatment of patients with edema were in no way as striking as the results of treatment of shock in burns. Plasma is inadequate as a means of combating the edema, which is a nutritional edema, because of the small amount of protein furnished by large amounts of plasma when compared to the needs of the organism. One liter of therapeutic plasma contains only about 50 grams of protein, which, as will be indicated, is only a small part of the nutritional need of the patient with edema.

The estimation of the status of a burn patient with regard to the presence or degree of protein deficiency is not simple. The factors necessary for a critical evaluation are (1) optimum weight of the patient, (2) observed weight of the patient, (3) plasma protein level, (4) plasma albumin level, (5) plasma volume, (6) nitrogen intake, and (7) nitrogen output. Actually, main reliance in clinical work has to be placed on a nutritional history, on the patient's weight, and on serum protein determinations done most simply by some densitometer method.

Elman (60) was the first to stress the patient's weight in evaluating protein depletion. It is practical to weigh bedridden burn patients by weighing them on a stretcher at the time of dressing changes just before the dressing is removed and then weighing the removed dressing and the stretcher. As soon as a surgeon commences to weigh his patients with burns he will be amazed at some of the losses encountered in patients that do not have very severe burns. Losses of more than 25 kilograms have been reported as occurring in a few weeks after a severe burn in spite of efforts to maintain nutrition (178).

Failure to meet the increased nutritional demands of the severely burned patient results in progressive loss of weight and strength, edema, friable granulations, increased local infection, and, finally, death from malnutrition. It is preferable to anticipate the requirements of the patient and to meet them before severe malnutrition occurs. In the very severely burned patient this may require as much as five or more times the normal intake of nitrogen. It has been indicated that the principal

[1] This is the 1½ ounce nylon cloth used for parachutes. It is not more than .1 millimeter thick and has a strength of 50 pounds per square inch in each direction. The warp is made of 40 Denier threads, 117 threads to the inch, and the woof of 60 Denier threads, 78 to the inch.

foodstuff required is protein. However, the food provided must be an adequate metabolic mixture containing, in addition to adequate amounts of protein, sufficient calories, carbohydrates, minerals, water, and accessory food substances. Whenever possible, protein losses or deficiencies should be corrected by oral feeding. It is not enough for the surgeon to order a "high protein, high caloric, high vitamin diet." If such a diet is ordered the patient may fail to benefit from the order for any one of the following reasons: (1) the diet presented to the patient is not as specified; (2) the diet presented is not eaten in whole or in part because it lacks palatability, there is lack of appetite, and there is a lack of nurses to encourage eating; and (3) food eaten may be partly or wholly lost because of diarrhea or vomiting.

The three items listed under No. 2 are interrelated. It is common experience to find that a sick patient has "no appetite." However, if special attention is paid to the likes and dislikes of the patient and special or other nurses are available to encourage eating and to offer meals when the patient desires them instead of only at stated routine periods, many such patients will eat a surprisingly large amount of food.

The two items under No. 3 are also related to each other. Forcing the diet in a sick patient does not always result in a net gain. Nausea, vomiting, distention, and diarrhea, singly or together, are limiting factors. In general, the sicker the patient the less fat is tolerated, and the larger the proportion of protein that is required. It has been found that at least 25 per cent of the calories in the diet should come from protein and not over 15 per cent from fat if any of these intestinal symptoms have occurred recently. Some patients will need 50% of their calories in the form of protein. It is well to take a number of days to increase the food intake, as sudden increases are more likely to be followed by gastrointestinal symptoms. More cautious increases will prevent such symptoms. If the diet is not tolerated, protein in the form of a digest should be tried and frequently will be well tolerated. The available digests are not particularly palatable and should be given by intubation if refused by the patient.

Intubation feeding is important and may be used to increase the intake of food greatly. Medium caliber nasal stomach tubes are used and left in all the time or for many hours a day. If left in continuously, the tube should be removed every third or fourth day for cleansing. About 200 cubic centimeters may be given at a time, spaced between meals and at night, but there is a wide variation in the amount and frequency of supplementary tube feedings that different patients will take. It is well to start with half skimmed milk and half water or with a mixture of protein hydrolysate and carbohydrates and increase the strength and quantity of the mixture over a period of days. Instead of supplying the mixture in intermittent doses, a drip apparatus may be used which can, after a short period of training, be regulated by some of the patients themselves. If from 125 to 150 grams of protein and from 2,000 to 2,500 calories are given by intubation in addition to an average house diet, the patient should receive a total of about 200 grams of protein with over 4,000 calories.

Some of these patients will require protein and carbohydrate supplements given intravenously as well as by intubation. This has already been discussed by Tagnon and associates (173) and by Lund and Levenson (125), and by Elman (59).

CHRONIC ANEMIA

As noted in an earlier section there is an acute hemolytic process starting immediately after an extensive deep burn and continuing for about 72 hours. The actual number of red blood cells hemolyzed during this period is usually relatively small. However, following this there is a chronic anemia which continues until healing is complete.

This anemia is progressive and its chronicity and severity are roughly proportional to the extent of unhealed deep burn. It does not respond to large intakes of iron, liver extract, protein calories, and vitamins, although these must be given for nutritional purposes. Blood transfusions are necessary at frequent intervals and in large amounts to maintain the hemoglobin at a satisfactory level. In the past it has usually been recommended that the burn patient should be transfused with type specific blood when the hemoglobin falls below 75 per cent, but it has been learned that he does better when his hemoglobin is kept above 85 per cent. To accomplish this may require as much as 1 liter or more of blood every week during the patient's entire course of illness. If available, red blood cells suspended in saline solution are as satisfactory as whole blood (172).

The cause or causes of this chronic anemia are poorly understood. One factor may be chronic hemolysis. In support of this concept Moore and Cope (46) have found an increased excretion of red cell breakdown products. Emerson and Ebert recently demonstrated that pooled plasma and type O whole blood given to patients with types A, B, or AB blood induces a persistent and severe

hemolytic process. This is detected by finding an increase in bilirubin in the plasma. Hemoglobinemia and hemoglobinuria are not found. Another factor in some cases is loss of blood into the dressings. This is particularly marked when the granulations are "poor" and edematous in patients that are not in nutritional balance. The bone marrow is not markedly depressed as the reticulocyte count frequently reaches 5 per cent.

SEX HORMONES

In severe burns in young women menses cease and do not commence again until healing is nearly complete. At the same time, these patients develop an abnormal growth of hair, especially on their arms and legs. This hair disappears about the same time menses recommence (115, 47). No similar change is noted in men. Attempts to treat the metabolic effects of burns with a growth promoting sex hormone (testosterone) in the early stages have not met with success (24, 95). Recently, following a suggestion made by Browne (24), testosterone propionate has been used with considerable clinical success in the late stages of burns at the Boston City Hospital. It was not possible to study the nitrogen excretion in these cases, but clinically they responded in a manner that indicated an increased positive nitrogen balance. The pain decreased, the granulations improved, the appetites increased, and weight was gained very rapidly. The dose used was 10 milligrams per day, given intramuscularly. This hormone has given this good effect to patients of both sexes.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

EYE

Donegan, E. A.: Ocular Findings in Tropical Typhus (Tsutsugamushi or Japanese River Fever). *Brit. J. Ophth.*, 1946, 30: 11.

Donegan reports the ocular findings in a series of 101 cases of tropical typhus, or Japanese fever, at the India-Burma border. The disease is closely related to the louse-borne typhus which occurred during World War I (1914–18) in the Balkans and in Russia, and during World War II in Italy, as well as the tick-borne typhus throughout the world. Rickettsia orientalis is the causative organism and its insect vector is a mite that is usually found where there is dead wood, low scrub, and rotting vegetation. Tropical rats and birds are the reservoirs of the disease.

Ninety-six West Africans and 6 Europeans were affected. The patients usually presented headache, apathy, enlargement of the spleen and liver, pulmonary congestion, hyperemia of the conjunctiva, blurring of the margins of the optic disc, optic neuritis and haziness of the vitreous. Many cases showed evidence of the descending neuritis described by von Graefe, which disappeared without residual damage to the optic nerve or retina.

There were only 2 cases of optic atrophy in the present series, 1 of which was syphilitic. The mortality was 4 per cent. JOSHUA ZUCKERMAN, M.D.

Paul, M.: Cavernous Hemangioma of the Orbit Successfully Removed by Shugrue's Operation. *Brit. J. Ophth.*, 1946, 30: 35.

The author describes a cavernous hemangioma of the orbit which was successfully removed by Shugrue's method of operation which involves an approach to the lateral wall of the orbit beneath the zygomatic bone, removal of the lateral orbital wall, and removal of the tumor. The major complication of this operation is the possibility of injury to the lateral rectus muscle. The advantage is in the adequate exposure of the tumor which does not interfere with the future function of the eye. In the author's case, removal of the tumor gave a satisfactory result. HUNTER H. ROMAINE, M.D.

Meenan, P. N.: The Etiology of Trachoma in Ireland (Preliminary Communication). *Irish J.M. Sc.*, 1945, 239: 670.

The author discusses the etiology of trachoma in Ireland, where it has recently become more prevalent. He points out that trachoma causes approximately 9 per cent of the cases of blindness in Ireland, but only 0.81 per cent in Scotland.

At present, the causal agent of trachoma is considered to be either a rickettsia or a virus. There is some evidence in favor of the rickettsial theory. Typical rickettsias are not filtrable and they confer immunity.

There is also evidence in favor of the virus theory, which was advanced in 1907. The infective agent is filtrable. The presence of inclusions composed of elementary bodies constitutes the earliest recognizable change in trachoma and is demonstrable in all cases at their onset.

Whether viral or rickettsial in origin, these bodies are considered the causal agent of trachoma. They are morphologically indistinguishable from those of psittacosis, inclusion conjunctivitis, and lymphogranuloma venereum. The virus has never been grown in the laboratory. Infection with trachoma does not confer permanent immunity.

It seems that the Castaneda positive viruses are closely related. They may all have a common ancestry and the specific differences may have been acquired by prolonged residence in a particular animal species or tissue. JOSHUA ZUCKERMAN, M.D.

Pereira, R. F., and Tolosa, E. E.: Dacryosinusitis Simulating a Dacryocanaliculitis (Dacriosinusitis simulando una dacriocanaliculitis). *Sem. méd., B. Air.*, 1945, 52: 893.

The author describes a rather remarkable case in which pus from the ethmoid cells was draining through a fistula from the involved sinuses and then through the superior lacrimal canal into the right eye.

Fluid instilled into the incised inferior lacrimal canal, which contained a slight amount of pus, passed readily into the nasal cavity, apparently through the normal opening into the nose; then the superior canal was incised, but no pus could be expressed from the lacrimal sac. A probe was passed into the nasal cavity in the region of the ethmoid cells and its position verified with x-rays.

The patient was now referred to the ear, nose, and throat department, where the condition was diagnosed by direct examination as hypertrophy of the right superior turbinate due to edema of the meatus on the right side; and by roentgenography, because of the opacity of all the sinuses on the right side—especially the ethmoidal and maxillary—as a maxilloethmoidal sinusitis. An operation, designated as that of Ermiro de Lima, was performed. This operation permits supervision of the maxillary sinus, and at the same time gives access to, and permits evacuation of, the entire ethmoid system. At this operation there was encountered intense hyperplasia of the

mucosa of the ethmoid cells. These cells were full of fetid pus, and their intercellular walls were broken down.

In a few days the patient had healed normally, with disappearance both of the secretion into the conjunctival sac, and of the fistulous opening into the nose. Re-examination a few months later disclosed complete absence of all signs of infection of the nose and eye; fluids passed normally into the nose through both the superior and inferior lacrimal canals, and the probe could no longer be passed through the fistulous opening into the ethmoid region of the nose. JOHN W. BRENNAN, M.D.

De Roetth, A.: Hypofunction of the Lacrimal Gland and the Sjögren Syndrome. *J. Lancet*, 1945, 65: 423.

The author states that diminished lacrimal secretion may be due to congenital absence, surgical removal, or destruction (by radiation) of the lacrimal gland, the presence of toxins, and endocrine dysfunction.

The most marked form of hypofunction is known as filamentary keratitis. The condition is characterized by epithelial filaments which present knobs at their free ends. The less marked type is called keratoconjunctivitis sicca, which presents a stringy, ropy, mucoid discharge, photophobia, burning, grittiness, round gray epithelial dots, and hypesthesia of the cornea. The Schirmer test shows only from 3 to 6 mm. of moistening in 5 minutes.

Another type of hypofunction occurs as part of the Sjögren syndrome in association with dryness of the mouth, nose, and larynx, due to decreased function of the salivary glands. About 50 per cent of patients with this type of hypofunction have chronic arthritis.

The mildest form of hypofunction is difficult to recognize. It is characterized by vague symptoms such as fatigue or heaviness of the eyes, dryness of the nose and mouth, and difficulty in reading, especially by artificial light. However, the Schirmer test is positive.

Therapy consists in occlusion of all the puncta, the instillation of tear substitutes such as sodium chloride, egg albumin, liquid petrolatum, fibrolysin, or Gifford's solution, the administration of ovarian extract, and the removal of foci of infection.

JOSHUA ZUCKERMAN, M.D.

Hymes, C.: Scleral Flap Incision with Scleral Sutures for the Cataract Operation. *Arch. Ophth.*, Chic., 1945, 34: 374.

The author describes a method of cataract extraction in which a scleral flap incision is made and scleral sutures are used.

After retrobulbar injection anesthesia and akinesia of the orbicularis muscle, a superior rectus muscle suture is inserted for retraction of the eyeball. A conjunctival flap is dissected 3 mm. above the upper limbus, and a concentric wedge shaped scleral flap, with its base at the limbus, is then made with the use of a Lundsgaard or Hymes concave knife. This is started at about 1 to 5 mm. above the upper limbus and the conjunctival flap is left attached to it. The corneal section is then made with a keratome and enlarged with scissors, Before extraction of the cataract, a single suture is inserted—first through the conjunctiva, then through the lower lip of the sclera, the upper lip of the sclera, and finally through the upper lip of the conjunctiva. The loop is laid aside. After the cataract has been extracted the suture is pulled taut, and tied.

The author is of the opinion that with this procedure, a firmer and more accurate closure of cataract wounds is obtained, and the incidence of postoperative complications and of astigmatism is reduced. JOSHUA ZUCKERMAN, M.D.

Chamlin, M.: The Effect of Talc in Ocular Surgery. *Arch. Ophth.*, Chic., 1945, 34: 369.

The author discusses the effect of talc (generally used on surgical gloves) on the ocular tissues.

In a series of experiments on the eyes of rabbits, he simulated the accidental introduction of talc into the ocular tissues during surgical procedures. He found that talc produces foreign body granulomas in most eyes.

To avoid this undesirable possibility, he recommends directing a stream of saline solution from an irrigator at the surgeon's gloved hands before operation, instead of immersing them in saline or other solutions. JOSHUA ZUCKERMAN, M.D.

EAR

Conley, J. J.: The Treatment of Chronic Suppurative Otitis Media with Penicillin. *Arch. Otolar.*, Chic., 1945, 42: 374.

Penicillin therapy is of little help in patients with chronic suppurative otitis media which has proved resistant to sulfonamide compounds. The response of chronic suppurative otitis media to systemic treatment with sulfadiazine followed by 1,000,000 units of penicillin is insignificant. The response of chronic suppurative otitis media to local penicillin therapy is good; 53 per cent of the cases treated were definitely improved. Granulation tissue and cholesteatomas are not affected by sulfadiazine or penicillin, whether administered generally or locally.

The best treatment for acute and chronic suppurative otitis media is to prevent their occurrence by the prophylactic use of one or both of the chemical and biological therapeutic agents.

NOAH D. FABRICANT, M.D.

Moreira, D.: Gradenigo's Syndrome (Sindrome de Gradenigo). *Fol. med., Rio.*, 1945, 26, 146.

The author reports on a patient with a syndrome consisting of acute otitis media, neuralgia of the trigeminal nerve, and paralysis of the sixth pair of cranial nerves, which was first described by Gradenigo of the Royal Academy of Turin in 1904 and since then known under his name. This is the tenth case

reported in the Brazilian literature and possibly the first from Brazil with contralateral paralysis.

The patient was a Brazilian mulatto, 30 years of age, who had atrophic rhinitis and upon admittance had been suffering with a suppurating left ear for about 20 days. After repeated myringotomy and intense treatment with 4, and later 3, gm. per day of sulfanilamide the condition improved, but somewhat over a month later intense temporal and retrobulbar headaches occurred and paralysis of the abducens nerve developed, all on the right side. At no time did otoscopy or roentgenography show any evidence of changes in the right ear or other (mastoid or petrosal) regions. There was some doubt at this time of any changes in the mastoid cells of the left side and there was a slight mucoid discharge from the left ear, but nothing suggested the sudden change in the patient's condition.

Treatment with sulfanilamide, combined with antipyogenic vaccine and vitamin B, was instituted and 2 months later the patient was entirely well, the eye movements having become entirely normal.

An interesting coincidence was the sudden occurrence of fever, about 10 days before recovery, with the discovery of plasmodium vivax in the blood.

Altogether, the patient had undergone 8 myringotomies and received 15 ampoules of antipyogenic vaccine, 418 milligrams of vitamin B, and 52.75 grams of sulfanilamide. JOHN W. BRENNAN, M.D.

NOSE AND SINUSES

Cenget, D. D., Possi, R. A., and Socci, A.: Rhinosporidium Seeberi Granuloma; The First Case in Tucumán (Primer caso en Tucumán de granuloma por rhinosporidium Seeberi). *Arch. farm. bioquim.*, Tucumán, 1945, 2: 19.

The authors report a new case of granuloma produced by the rhinosporidium Seeberi, the seventh case reported in Argentina, and the first found in Tucumán. It shows a geographic zone so far unknown with regard to this parasite.

This parasite is a fungus of the order of the chytridiales, belonging to the olpidiáceae family. The mechanism of human infection as well as that of infection of possible intermediary hosts is unknown. The fungus produces a chronic inflammatory hypertrophy which results in polyps of the nasal mucosa. Photographs of microscopic sections in the original article show all the developmental phases of the parasite. HEINRICH LAMM, M.D.

Peer, L. A.: The Neglected Septal Cartilage Graft, with Experimental Observations on the Growth of Human Cartilage Grafts. *Arch. Otolar.*, Chic., 1945, 42: 384.

The general belief that autogenous septal cartilage grafts do not survive after transplantation is erroneous. Autogenous septal cartilage, alar cartilage, lateral cartilage, and rib cartilage all survive after transplantation as living cartilage. All may be used successfully for grafting purposes. Autogenous septal cartilage is superior to alar and auricular cartilage only because of its greater bulk and firmer structure. It is superior to rib cartilage because it is more readily obtainable. Autogenous septal cartilage should be used whenever a nasal defect can be adequately supported by the patient's septal cartilage with the addition of septal bone when necessary.

When the nasal depression is sufficiently large to require rib cartilage, autogenous cartilage is the material of choice. Preserved cadaveric cartilage may be used in debilitated or elderly patients. Experimental observations indicated actual growth of young human auricular and septal cartilage grafts. The more bulky young rib cartilage grafts increased in some cases and in others showed no increase in size. Septal bone grafts without periosteum transplanted beneath the abdominal skin retained their normal bone structure for periods up to 4 years after transplantation. Rib and tibial bone, with and without periosteum, transplanted beneath the abdominal skin completely disappeared 7 months after transplantation. NOAH D. FABRICANT, M.D.

Berger, M.D.: Neoplasms of Both Maxillary Sinuses. *Arch. Otolar.*, Chic., 1945, 42: 397.

Because of the apparent rarity of cases in which both maxillary antrums were invaded by neoplasms, a careful scrutiny of the literature was undertaken in order to determine whether any such case had been previously reported. During the past 20 years there has been no report of a case of bilateral neoplastic involvement of the antrums. The author observed cancerous involvement of the two maxillary antrums in a patient 62 years of age. The neoplasms were separate and distinct entities. The second growth developed while the patient was under observation. NOAH D. FABRICANT, M.D.

PHARYNX

Morley, J.: Pharyngeal Diverticula. *Brit. J. Surg.*, 1945, 33: 101.

The author presents 21 cases of pharyngeal diverticula treated by one stage resection and suture.

Two cases of pharyngeal diverticula complicated by squamous epithelioma originating in the pouch are recorded.

Hurst's anterior pharyngoesophageal pouch is demonstrated with the aid of barium in the vallecula between the tongue and the epiglottis.

The technique and results of the one stage excision operation are described, and its advantages as compared with resection in two stages are set forth. JOHN F. DELPH, M.D.

NECK

Lesses, M. F., and Gargill, S. L.: Thiouracil as a Cause of Neutropenia and Agranulocytosis. *N. England J. M.*, 1945, 233: 803.

The authors treated 62 patients with thiouracil. Of these, 61 had thyrotoxicosis and 1 had angina

pectoris. Five patients developed neutropenia and granulopenia. Of these, 1 (with thyrotoxicosis) died of agranulocytic angina; another of the 5 patients developed a sore throat but recovered; 1 patient, with granulopenia, recovered with continued administration of thiouracil.

Fifty-four cases reported in the literature, and 5 personal cases of neutropenia following the administration of thiouracil, are classified in 3 groups, as follows:

Group 1 includes 36 cases of asymptomatic neutropenia and granulopenia (often confused with the mild neutropenia and lymphocytosis of toxic goiter); group 2 includes 11 cases of significant neutropenia, frequently associated with symptoms, especially fever and pharyngitis, which readily subsided on discontinuance of the drug, the patients sometimes recovering with continuation of the drug; group 3 includes 8 cases of severe granulopenia, many with a typical picture of agranulocytic angina, and 4 of which ended fatally.

The authors discuss the relative benefits and dangers of thiouracil therapy as compared with the dangers of thyrotoxicosis and thyroid surgery. They point out that whereas most deaths following thyroidectomy are in patients with severely toxic goiters, thiouracil may cause the death of patients with mild thyrotoxicosis.

In analyzing the possible mechanisms of thiouracil neutropenia, the authors state that marrow biopsies indicate both destruction of mature granulocytes and inhibition of the development of premyelocytes.

Hypersensitivity appears to be the conditioning factor in the production of granulopenia with thiouracil. "Thiouracil definitely falls into the group of drugs that produce allergic manifestations—namely, drug fever, urticarial and other types of skin eruptions, and reproductions of toxic symptoms with readministration in small doses."

Thyrotoxicosis seemed not to be a factor in agranulocytosis due to thiouracil since it occurs in the absence, and during remissions, of thyrotoxicosis. Dosage and duration of treatment also seemed to be not important.

Both sensitization and desensitization have been observed.

Patients who receive thiouracil must be under constant supervision. Since the onset of neutropenia and agranulocytosis is not detectable without blood counts, it is recommended that white cell counts be made three times weekly. The authors advocate the following treatment of agranulocytic angina associated with thiouracil: withdrawal of the drug, blood transfusions, and the administration of penicillin, liver extract, pentnucleotide, and yeast.

CLINTON H. THIENES, M.D.

Lore, J. M.: Stripping of the Vocal Cords. *Arch. Otolar.*, Chic., 1945, 42: 378.

Experimental stripping of the vocal cords in cats established the fact of vocal cord regeneration. Application of this operation to the human larynx confirmed the experimental findings.

All types of benign lesions lend themselves to the stripping operation. Hyperkeratotic papilloma can be cured by this operation.

General anesthesia supplemented by local anesthesia induced by the application of a solution of such anesthetic drugs as cocaine hydrochloride or tetracaine hydrochloride is the anesthesia of choice.

The operative technique has proved satisfactory. The postoperative management with silence or the whispered voice is questioned. Better end results have been obtained by permitting reasonable use of the voice. Functional results have been good.

The satisfactory results obtained warrant the continued application of the principles of this operation.

NOAH D. FABRICANT, M.D.

SURGERY OF THE NERVOUS SYSTEM

PERIPHERAL NERVES

Tolnick, B., and Beck, W. C.: The Histamine Flare in the Evaluation of Peripheral Nerve Lesions. *War. Med.*, Chic., 1945, 8: 386.

As an adjunct to other objective tests in the diagnosis of peripheral nerve lesions, the authors advocate and describe the histamine flare test. The test consists of an intradermal injection of 0.1 c.c. of a 1 to 1,000 solution of histamine phosphate in the affected extremity, and as a control test on the unaffected side. The small red reaction at the site of injection and the wheal which follows it have no diagnostic importance. The flare comes later and its intensity and dimensions vary. It depends on an intact arteriolar circulation and on an intact axon reflex. Thus, the presence of the flare will indicate that both the local nerve supply and the local blood supply are present, and the absence of a flare will indicate that either the blood supply is absent or the peripheral nerve supplying the area has undergone degeneration.

From their limited observations, the authors suggest that in the absence of a flare the nerve is completely divided and requires early surgical repair. They interpret the appearance of a partial flare as due to a concussion or edema of the nerve, for which recovery will be spontaneous without operative intervention.

The presence of the histamine flare, being entirely dependent on the degeneration of the axon, furnishes also an objective test in the differentiation between the hysterical and the organic anesthesias. It may also be of value in the differential diagnosis of hysteria and malingering. The injection of histamine is painful and the malingerer will almost always give evidences of pain or of pruritus.

GEORGE PERRET, M.D.

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Grunnagle, J. F.: Early Treatment of Open Head Wounds. *War Med.*, Chic., 1945, 8: 376.

The author's article deals with his experience in the treatment of open head wounds in a general hospital during a period of 7 months in the Philippine campaigns. Forty per cent of the patients suffered infections of various types, and the mortality was 1 per cent.

The objectives in the treatment of craniocerebral injuries are the preservation of life, the preservation of function, and the prevention of infection. The elimination of infection will do much toward the accomplishment of the two other objectives, and prevention will depend almost entirely upon the application of sound first aid measures and the early definitive surgical repair.

The first aid measures include, mainly, the treatment of shock and the loss of blood, drainage of a distended urinary bladder, the institution of systemic sulfonamide and penicillin therapy, shaving and cleansing of the scalp, the application of a large sterile dressing, the administration of tetanus toxoid, and prompt evacuation of the patient to a hospital equipped for definitive surgical intervention on such wounds.

The optimum time for débridement is within the first 6 hours following injury, but it can be done after a longer interval has elapsed if adequate penicillin and sulfonamide therapy have been instituted. The author strongly advocates early and complete débridement of all involved tissues, and closure of the wound without drainage as the best means of preventing infection. All patients in whom the scalp had been débrided and left open and a sulfonamide dressing had been applied, arrived in the rear area with varying degrees of infection and slough. All scalp wounds which had been débrided and closed, with drainage, were infected, and some of them had broken down. On the other hand, all wounds which had been débrided and closed tightly, without drainage, had healed with no evidence of infection, which proved the efficacy of that method of treatment. The author believes that the same principles should be applied in the treatment of fractures of the skull. He emphasizes the importance of the removal of all foreign material, fragments and contaminated bone.

Cases in which the dura had been torn showed severe and extensive damage as the result of infection. Such complications consisted of infected cerebral herniations, meningitis, or brain abscess, in addition to osteomyelitis of the skull and cellulitis. Neither herniation nor infection cccurred in patients in whom early and adequate débridement and closure had been accomplished. The author states that, if necessary, closure of the dura can be obtained by the use of a graft taken from the sheath of the temporal muscle, periosteum, or fascia lata. The same observations were made following the treatment of more extensive cerebral lacerations. The removal of all lacerated cerebral tissue, bone fragments, blood clots, and debris by careful irrigation and suction is recommended. Closure of the dura, to avoid cerebral herniaton, is of primary importance.

Fractures extending into the nose and the nasal accessory sinuses, and basilar fractures with escape of cerebrospinal fluid (without associated lacerations) were treated conservatively.

Increased intracranial pressure was treated by elevation of the head, limitation of fluid intake, the intravenous administration of 10 per cent dextrose in distilled water, and magnesium sulfate retention enemas.

The author believes that penicillin and sulfonamides should be given to all patients with severe

craniocerebral injuries, but that the use of these drugs does not replace proper and early surgical débridement and repair. Drains offer a pathway for the entrance of infection and should therefore be avoided. Tight closure of the débrided wound is the best safeguard against infection.

GEORGE PERRET, M.D.

Wycis, H.: Bilateral Intracranial Section of the Glossopharyngeal Nerve; Report of a Case. *Arch. Neur. Psychiat.*, Chic., 1945, 54: 344.

This brief article gives a concise review of the surgery on the glossopharyngeal nerve, and a résumé of the effects of the glossopharyngeal nerve on the carotid sinus mechanism.

A case report is given of a patient who was operated upon with bilateral section of the glossopharyngeal nerve for the pain of carcinoma of the epipharynx. On section of the nerves a dramatic rise in blood pressure, pulse, and respiratory rate was noted, whereas previous to operation these figures had been at a normal low level, the carotid sinus had not been sensitive to manipulation, and the electrocardiogram was normal. The pulse and respiratory rate remained high for 3 days, and the hypertension persisted for 4 weeks, not reaching the preoperative levels until 5 days prior to the death of the patient, when there were signs of circulatory failure. The patient died of suppurative pneumonitis 1 month after operation, due, not to inability to swallow because of the section of the glossopharyngeal nerves, since at all times postoperatively the patient suffered no dysphagia, but rather to a constantly sloughing epipharyngeal mass which discharged continuously into the lower pharynx. In and of itself, bilateral section of the glossopharyngeal nerve is compatible with normal life.

JOHN MARTIN, M.D.

Woolf, J. I.: Acute Hypertension with Sodium Pentothal Anesthesia in Neurologic Surgery. *Ann. Surg.*, 1945, 122: 1146.

Acute arterial hypertension which occurs during the subtemporal approach to the gasserian ganglion has been reported when sodium penthothal anesthesia is used. This rise in blood pressure is well defined, and in 10 consecutive cases averaged 51.3/32.5 mm. of mercury.

A similar rise in blood pressure did not occur when ether anesthesia was used.

Further studies were conducted upon patients operated upon for herniated intervertebral discs under sodium pentothal anesthesia. No elevation of the blood pressure could be demonstrated.

It was also noted that the final blood pressure was higher in both the dislocated intervertebral disc series as well as the gasserian ganglion series when they were operated upon under sodium pentothal anesthesia. It was therefore suggested that postoperative shock was less likely to occur under such anesthesias.

It is not possible to give an entirely satisfactory explanation for the acute hypertension noted exclusively in the patients operated upon for section of the sensory root of the gasserian ganglion. It is suggested that there may be a hypersensitivity of the cerebral vasomotor centers under pentothal anesthesia. Retraction of the temporal lobe may result in widespread pressure or irritative effects, although the site of vasomotor stimulation is not known.

No untoward effects were noted as the result of this temporary hypertension during surgery.

HOWARD A. BROWN, M.D.

SPINAL CORD AND ITS COVERINGS

Shenkin, H. A., Horn, R. C., Jr., and Grant, F. C.: Lesions of the Spinal Epidural Space Producing Cord Compression. *Arch. Surg.*, 1945, 51: 125.

The authors review the spinal extradural compressive lesions encountered in a 10 year period (1934–1944) in the material of the Laboratory of Neurosurgical Pathology of the Hospital of the University of Pennsylvania. These formed a series of 54 cases and comprised, roughly, 30 per cent of the total number of mass lesions of the spinal canal. The lesions are classified pathologically, and described.

Metastatic carcinoma was proved in 9 cases. Of these, 8 patients were over 50 years of age, and 1 (a man with a probable primary kidney tumor) was 27 years of age. Symptoms of root compression appeared first, followed usually after a period of several months, by cord compression. Progression was rapid and the systemic nature of the process was suggested by weight loss. Roentgenograms showed vertebral erosion. In 6 of the 9 cases the primary site of the lesion was never determined. In addition to the kidney tumor, primary carcinoma of the lung was discovered in 2 cases. Decompression gave relief of pain but failed to relieve the symptoms of cord compression.

All of the tumors were friable and encircled the dura. The laminae and spines were extensively involved. Five of the lesions were adenocarcinomas, 2 were squamous cell epitheliomas, and 2 were undifferentiated.

In 7 patients in the fifth to seventh decades of life, myelomas were found. All patients had symptoms of a sudden onset of cord compression. Roentgenograms showed vertebral erosion and complete spinal subarachnoid block. In one-half of the cases there were symptoms of premonitory root irritation. Complete studies were made in 4 of the cases and in only 1 case was the vertebral lesion shown to be an isolated one. There were no alterations in serum proteins and the presence of Bence-Jones protein in the urine was not observed in the 3 cases in which these examinations were carried out.

The epidural mass found at operation was extremely vascular. The tumors were composed of closely packed masses of cells resembling plasma cells. As a group, the patients succumbed rapidly, the longest survival being 14 months.

Six cases of neuroblastoma (sympathicoblastoma) were found. Three of the patients were between 9

and 12 years of age, and the remaining 3 were 6 months, 22 years, and 67 years of age. The two older patients had had pain for a period of 6 months prior to cord compression; the duration of pain in the other 4 patients had been less than 1 month. Roentgenological evidence of vertebral involvement was noted in 2 cases; a retroperitoneal mass was present in 4 cases, and a posterior mediastinal tumor in 1 case. The tumors appeared bluish-red and very vascular, and tended to infiltrate into the paravertebral muscles. The majority of the tumors were located in the lower dorsal and upper lumbar regions. The six-months-old infant is living, 1 year after operation, and has shown some neurological improvement; the other 5 patients are dead.

The histological appearance of the tumors was that of solid cord, or small nests of tumor cells separated by delicate fibrous bands. The cells were small, with scanty cytoplasms. The nuclei were usually oval and hyperchromatic. Silver stains showed delicate reticulin fibrils. Some of the tumors showed larger cells with nuclei containing clumps of chromatin. These were thought to be sympathoblasts, as described by Rix and Geschickter. In 1 case the tumor may have been primary in bone; in the other cases it seemed to have invaded the epidural space from the retroperitoneal space or the posterior mediastinum.

In 3 patients, giant cell tumor of the bone occurred during the second decade of life. All 3 had root irritation as the first symptom, followed, after a period of several months, by the abrupt onset of cord compression with rapid progression of symptoms. All lesions were in the midthoracic region, and roentgenograms showed bony erosion. There was no history of trauma. At operation, the authors found an encapsulated tumor mass, usually not connected with bone. All 3 patients are well after surgical curettage and postoperative irradiation after 2, 3-½ and 9 years respectively. The tumors were composed of giant cells scattered in a vascular and cellular stroma. These cells were of the same type as those seen in giant cell tumors of the bone. The sections of 2 of the lesions showed extensive new bone formation.

In the group of miscellaneous epidural tumors there were 2 cases of lymphosarcoma occurring in patients 35 and 21 years of age, each of whom had root involvement and cord compression as their first symptom. In both cases the gross and histological appearances of the tumors were characteristic. Sixteen and 10 months after operation, followed by intensive irradiation, both patients are in good general condition and able to get about with the aid of canes.

One case of lipoma in a 45 year old patient, and 1 of liposarcoma in a 42 year old patient are reported. In the former, there was a slowly progressive paraparesis with no symptoms or signs of root involvement, and surgical decompression was followed by complete recovery. In the latter, root pain for 1 month was followed by complete paraplegia which developed in 24 hours. At operation, a red beefy mass involving the eighth thoracic vertebra was found. The patient was unimproved by operation.

An encapsulated hemangioma caused progressive weakness in a 54 year old woman. This was completely removed and the patient made a full recovery. Another blood vessel tumor, a malignant "hemangiopericytoma," metastasized to the epidural space from the thigh in a 43 year old man. His symptoms were not relieved by operation and death occurred after a period of 5 months.

In a case of acute monocytic leucemia in an 18 year old girl, leucemic infiltration caused root pain and rapidly progressive quadriplegia. Death occurred on the ninth day after operation.

One completely extradural neurilemmoma was found in a 52 year old woman who had had symptoms of cord compression and root pain for a period of 7 months. At operation, the tumor was only partially removed, and the patient had relief for several months; however, there was a recurrence of the tumor and the patient finally succumbed to sepsis.

There were 2 unclassified tumors, one of which closely resembled a hemangioma, the other, a malignant neurilemmoma.

In 2 of the patients in this series, spinal extradural cysts were present. These were characterized by spastic paraparesis, and loss of position and vibration senses in the legs. Roentgenograms showed a fusiform erosion of the pedicles. Following operative removal of the cysts, both patients made complete recoveries.

Chronic epidural hematoma caused cord compression in 2 patients. Neither of these patients had any history of trauma, and the onset of symptoms was very sudden. At operation, the lesions appeared similar to those of an intracranial subdural hematoma. Following decompression, 1 patient was completely well; the condition of the other patient was unimproved. There was 1 case of acute epidural hemorrhage following trauma. This patient was not benefited by operation.

There were 6 cases of acute epidural abscess. The onset of symptoms was sudden and the progression rapid in all cases. The source of the infection, and the organism (hemolytic staphylococcus albus) were easily determined. The abscesses were very extensive, and only 1 patient was benefited by operation.

Two patients with tuberculous granuloma were operated upon. In each of these, the indications for operation were symptoms of cord compression, since tuberculosis was not proved until after operation. A diagnosis of tuberculosis usually contraindicates laminectomy.

Three cases of syphilitic gumma of the epidural space were observed. The Wassermann reaction of both the spinal fluid and the blood of all patients was positive. Except for root pain and cord compression caused by the gummas, these patients were free of symptoms of syphilis. All were given antiluetic therapy postoperatively and all were completely relieved of symptoms.

The authors' series also includes 3 cases of nonspecific granuloma. The symptoms were slowly progressive in all of the patients. Only 1 of the 3 was benefited by operation. ROBERT E. GREEN, M.D.

MISCELLANEOUS

Walker, A. E., and Johnson, H. C.: Principles and Practice of Penicillin Therapy in Diseases of the Nervous System. *Ann. Surg.*, 1945, 122: 1125.

Although systemic penicillin appears in the spinal fluid in only minute quantities when injected into a normal animal or person, the amounts are materially increased and will be sufficient to cause bacteriostasis for the more sensitive organisms when meningeal irritation, caused either by sterile media (such as air in pneumoencephalography) or by bacterial invasion, is present.

In intrathecal administration of the drug, the best diffusion and the highest levels are found in intraventricular injection. Injection into the cisterna magna gives the next best results, and injection into the lumbar subarachnoid space, the poorest. Both of the former routes are too dangerous for any but very extraordinary cases.

Intrathecal penicillin can produce toxic effects on the nervous system. Twenty thousand units in 1 c.c. of saline injected into an experimental monkey produces transient perianal paresthesias, and in some cases convulsions, coma, and death. A patient who was given 100,000 units of penicillin in 5 c.c. of saline developed urinary retention, saddle paresthesias, and paraparesis. It required 3 months for these symptoms to clear up. Neymann has reported 2 cases of convulsions, coma, and death when 50,000 units of penicillin were injected into the cisterna magna of patients with dementia paralytica. Convulsive manifestations are more likely to follow intraventricular injection of the drug, or its topical application to the cerebral cortex.

In the treatment of specific disease, penicillin should not be used for meningococcus meningitis unless sulfadiazine fails to yield improvement in from 24 to 48 hours. In this disease, intramuscular penicillin (40,000 units every 3 hours) should be used.

For streptococcal meningitis, intrathecal as well as systemic injection is required. This is also the case for staphylococcal meningitis.

In the treatment of pneumococcal meningitis, a disease that was uniformly fatal before the advent of chemotherapy, sulfadiazine plus both systemic and intrathecal penicillin should be used.

In the surgical treatment of compound fractures of the skull, from 5,000 to 20,000 units of either dry or aqueous penicillin may be placed in the wound; in addition, systemic penicillin should be given.

Before a brain abscess is drained, systemic penicillin (200,000 to 300,000 units) should be given daily. At the time of drainage 1,000 to 20,000 units may be instilled into the cavity.

Infected meningoceles and meningomyeloceles respond well to penicillin therapy.

Penicillin has a favorable effect on early neurosyphilis, but tuberculous meningitis, brain tumor, multiple sclerosis, amyotrophic lateral sclerosis, and cerebral degeneration are unimproved by the drug.

ROBERT E. GREEN, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Govan, A. D. T.: Two Cases of Mixed Malignant Tumor of the Breast. *J. Path. Bact.*, Lond., 1945, 57: 397.

The following 2 cases of mixed malignant tumor of the breast were reported not only because of the rarity of these growths, but also because the histological diagnosis appears to be unusually precise, and the similarity of the case histories and subsequent development makes them of clinical interest.

The patients were admitted to the Queen Elizabeth Hospital, Birmingham, England. Their ages were 37 and 47 respectively. They both complained of a progressive swelling of the breast which developed a discharge from the nipple. Examination revealed an enlarged nodular (cystic) breast, which was mobile. No other pathological conditions were elicited.

One patient was treated by excision of the breast, followed by deep x-ray therapy. The other was treated by a mastectomy, followed by x-ray therapy. Both patients made an uneventful postoperative recovery and were discharged to the x-ray clinic. They were readmitted to the hospital shortly after their discharge, the first patient complaining of a lump in the axilla and the second, of a lump in the incision. The patients received further surgical and x-ray therapy. Death occurred a few months later. Secondary metastases to the lungs and spine were found.

Laboratory examination revealed the growth to be well circumscribed and, in parts, almost encapsulated. It could be divided roughly into cystic and noncystic parts, which gave the tumor an irregular lobulated appearance. The cysts were irregular and hemorrhagic. They might well have been formed by necrosis of and hemorrhage into parts of the tumor. The neoplastic tissue consisted of solid, white, fleshy masses bearing little resemblance to the usual carcinomatous growths of this region. There was no suggestion of irregular or widespread infiltration of the normal tissue such as one finds in carcinoma. At all points the growth was clearly demarcated from the normal breast tissue.

It was at once evident on microscopic examination that two types of growth, carcinomatous and sarcomatous, were present. The carcinoma could be seen to have originated in the main ducts. It was absent from the tissue surrounding the hemorrhagic cyst and from the lobulated masses at the periphery. Here and there smaller and more irregular islands of carcinoma could be seen in the central portion, but always well defined and clearly differentiated from the second type of growth.

It must remain in doubt whether the sarcoma or the carcinoma was the cause of the metastases which were undoubtedly present. There was, however, no evidence of lymphatic permeation, and the subsequent history is one of early local recurrence with later metastases to the lungs and bones via the blood stream. These facts would suggest that it was the sarcoma which had disseminated, and indeed it would seem unlikely that a well differentiated carcinoma, with relatively few mitoses, would produce blood-borne metastases in such a short time.

The sarcoma cells were derived from the muscle; the majority of cells were spindles. Numerous giant cells also were present.

In general the growths were not vascular and little stroma could be demonstrated by ordinary methods, but silver impregnation revealed an abundant reticulum which closely invested the individual cells of the sarcomatous portion.

LEE PULLEN, M.D.

TRACHEA, LUNGS, AND PLEURA

Blackburn, G., and D'Abreu, A. L.: Thoracoabdominal Wounds in War. *Brit. J. Surg.*, 1945, 33: 152.

The authors analyze 126 cases of thoracoabdominal wounds treated at forward operating centers, and 74 cases treated in the surgical division of a base hospital. Of the 126 patients treated at forward operating centers, 46 (36.5%) died; of the 74 patients who reached the base hospital, only 3 died.

The distinction between thoracoabdominal wounds and abdominothoracic wounds is important. The great majority of wounds belong to the first group: the wound of entry is in the chest, and the foreign body or the wound of exit is below the diaphragm. The thoracoabdominal wounds respond more favorably than those of the opposite type, and are less likely to require laparotomy. Wounds of the right side tend especially to belong in this category, and if the liver is the sole abdominal viscus that is injured, a laparotomy need not and should not be undertaken. Only 8 of 65 right-sided wounds had an associated hollow viscus lesion, while 30 of 61 left-sided wounds had hollow viscus lesions, with a correspondingly greater mortality among the patients with left-sided wounds. The authors believe that laparotomy should be avoided, if possible. If, however, a laparotomy is necessary, a Kocher's incision will give excellent access. The type of thoracic operation also is subject to variation, most British surgeons being content with rib resection and closure of the pleura after repair of the diaphragm.

Nonoperative treatment of thoracoabdominal injuries has a place, especially for wounds on the right side, but certainty of diagnosis is difficult without radiography. A wound may be labelled thoracoabdominal only when (1) a foreign body, with an entry wound in the chest, can be demonstrated below the diaphragm; (2) hematuria is combined with hemothorax or hemopneumothorax; (3) the presence of a

pleurobiliary fistula is proved by thoracic paracentesis.

Although the mortality rate in those patients who survive the initial wounding and operative treatment is low, the morbidity rate is high.

The complications in the series of 74 cases were as follows:

Hemothorax, 28 cases; atelectasis, 15 cases; subphrenic abscess, 12 cases (6 with coincident empyema); empyema, 11 cases; empyema with pleurobiliary fistula, 7 cases; lung abscess, 2 cases; and liver abscess, 2 cases.

The management of hemothorax is no different from that in a simple thoracic wound. Re-expansion of atelectatic lobes after postural drainage and breathing exercises is the rule, and a course of sulfadiazine is often of value in reducing pyrexia where progress is slow. Both lung abscesses recorded in the table resolved without operation, but were treated with a course of parenteral penicillin.

The most significant complication is empyema. All cases of empyema are not due to infection of a hemothorax, since a considerable number follow lower lobe collapses, associated with serous effusions that become purulent. It is essential, therefore, to watch for signs of effusion constantly and to perform paracentesis thoracis if clinical or radiological signs develop. The diagnosis of pleurobiliary fistula is easily made by examination of fluid obtained by aspiration from the pleural cavity. Drainage should be instituted early, as loculation is likely if drainage is delayed. Significant diagnostic features of subphrenic abscess were hectic fever with its constitutional malaise, high leucocytosis, local tenderness and swelling, restricted rib movements, a diaphragm invisible radiologically, with a fluid level beneath it and an overlying sympathetic pleural effusion. Diaphragmatic hernia is uncommon as a sequel of thoracoabdominal wounds.

The causative missile is rarely seen during operation for thoracoabdominal injuries, but should be removed if easily accessible. In cases with retained foreign bodies, the liver is a common site, but the fate of retained missiles in the liver is difficult to ascertain. It may be wishful thinking to suggest that they do not often cause mischief. A case of fatal abscess occurring in the liver after removal of a foreign body is reported.

JOHN L. LINDQUIST, M.D.

ESOPHAGUS AND MEDIASTINUM

Nielsen, J.: Clinical Results with Rotation Therapy in Cancer of the Esophagus. *Acta radiol.*, Stockh., 1945, 26: 361.

Rotation therapy offers some fresh possibilities in dealing with cancer of the esophagus which has hitherto proved little amenable to curative treatment. The author's report is based on results obtained with the rotation method of treatment in the past 3 years. The clinical development of carcinoma of the esophagus (the most malignant and most rapidly lethal form and site of epithelial cancer) has hitherto been so quickly fatal that it is permissible already, after a relatively short period of observation, to draw certain conclusions with regard to the therapeutic effect.

Experimental studies and measurements on phantoms revealed that the most favorable degree of effect is obtained when the focus skin and the half layer values are as great as possible, and when the size of the field and the object, and the density of the latter, are as small as possible. With the use of 180 kilovolts, 0.5 mm. of copper, and 15 milliamperes, the intensity, measured in air, is 65 r/min. at a distance of 40 cm., and 42 r/min. at a distance of 50 cm. Each sitting can thus be given in a reasonably short period of time (10 to 15 minutes).

The material was comprised wholly of referred cases. No case was refused, not even at the preliminary examination. A considerable proportion of the patients were severely affected and much enfeebled, a number of them with marked cachexia, and with metastases to the lymph nodes in the neck, to the liver, the lungs, and the bones.

One hundred and ninety-four patients were treated by irradiation. Of these, 174 (90%) were given rotation therapy. Eight patients (4%) were so feeble upon admission that no treatment could be given. Twelve patients (6%), in whom the cancer was situated in the cervical part of the esophagus (most of these were women), or at the level of the jugulum (a not uncommon site in men), were given crossfire irradiation to multiple, fixed fields, but the author believes that the rotatory treatment will always have the advantage, essentially, over crossfire irradiation through fixed fields by increasing the depth dose, rendering the focal dose hemogeneous, and eliminating the risk of over-crossing effects.

The screening control requires that the patient shall be seated on a stool which during irradiation rotates about a vertical axis, while the roentgen tube is fixed in a position with the central ray directed horizontally. Only slight cutaneous reactions were observed, and, in spite of large daily and total doses, there were no general reactions except moderate leucopenia; nor were there any other unpleasant after symptoms. The total dose, which is reached in the course of from 5 to 6 weeks (sometimes 7 to 8 weeks, and a minimum of 3 weeks) is about 5,000 roentgens.

The roentgenological diagnosis of tumor in all the cases was verified by microscopy in 113 (60%). Squamocellular carcinomas of the esophagus, which constitute the majority of the carcinomas in that site, are not as highly differentiated as, for instance, carcinomas of the tongue and oral cavity, and would indicate a correspondingly greater radiosensitivity. There is, therefore, reason to contest the not uncommon belief that nearly all carcinomas of the esophagus are, histologically, of a strongly keratinizing squamocellular type, and consequently radioresistant.

When the question is of squamocellular carcinomas, which, on account of their comparatively slight

radiosensitivity, require a considerable amount of daily radiation, the reaction of the tumor will be all the greater, the shorter the full treatment time can be made; in other words, the higher single and daily doses can be given. If the treatment is extended over too long a period, there is time for the development of connective tissue reactions, with the result that not all the cancer cells become destroyed.

In 117 cases (four-fifths of those fully treated and two-thirds of the total number), complete or nearly complete primary freedom from symptoms was obtained; that is, almost normal deglutition and, roentgenologically, marked improvement of the passage. The improvement of the deglutition was of shorter or longer duration. Recurrences in the esophagus were not infrequent; they often occurred above or below the primary stenosis, and were then accessible to another palliative irradiation. In many cases the patient was able to swallow right up to the time of death, which in most cases was due to metastases or cachexia. The results so far show an indubitable improvement of the survival curve.

LEE PULLEN, M.D.

MISCELLANEOUS

Wood, H., and Sweetser, H. B., Jr.: Punctate Cerebral Hemorrhage following Thoracic Trauma. *U. S. Nav. M. Bull.*, 1946, 46: 51.

On the authors' hospital ship 2 fatalities were encountered from symmetrical, diffuse, punctate cerebral hemorrhage secondary to severe thoracic trauma and multiple fractures. The first case carried a diagnosis of atmospheric blast concussion; the second resulted from a fall. Histological study of the 2 cases revealed hardly any cerebral fat embolism as a basis for the punctate hemorrhages.

The first patient, injured by an atmospheric blast, had an extensive right thoracic and abdominal contusion, right hemothorax, puncture of the right lung, one fractured right rib, a fracture of the right humerus and right acetabulum, rupture of the spleen and liver, hematoma of the right adrenal gland, renal bleeding, mediastinal hemorrhage, and hemorrhages into the serous membranes of the thoracic and abdominal cavities.

The second patient was injured by a fall from a height of 25 feet, which resulted in an extensive right thoracic contusion, fracture of 6 right ribs, right hemothorax and atelectasis (with terminal acute lobular pneumonia), puncture of the right diaphragm and the liver, and hemorrhages into the serous membranes of the pleural and abdominal cavities. Each case was characterized clinically by progressive coma with no localizing neurological signs.

Both patients showed pulmonary fat embolism. The first case, in which there was fracture of the long bones, was much more extensive than the second. A fat embolus was demonstrated in a capillary of the cerebral white matter in the patient cited in case 1, but it was not associated with hemorrhage. No fat embolism was demonstrated in the cerebral white matter of the patient in case 2.

The hypothesis is presented that the force of the trauma to the thorax of these patients was transmitted to the venous circulation, and resulted in a retrograde wave of elevated venous pressure. The degree of force involved in these cases was sufficient to overcome the barrier of the one set of venous valves located near the termination of each internal jugular vein. From that level to the capillaries of the brain there are two direct, relatively short, columns of blood which are unprotected by venous valves.

The most abrupt change in vessel caliber is from the capillaries of the cerebral white matter and the basal nuclei to the great cerebral vein. The venous tract from the capillaries of the cerebral white matter, basal nuclei, and upper midbrain to the confluence of the dural sinuses is more direct, and is generally shorter than the tract from the capillaries of the cerebral cortex to the confluence of the sinuses. The angles at which the superior cerebral veins enter the superior sagittal sinus, and the presence of the folds of dura in relation to the ostia of these veins would tend to lend protection to the capillaries of the cortex from a retrograde wave of pressure.

In brief, a retrograde wave of venous pressure should strike the capillaries and venules of the cerebral white matter before it strikes those of the cerebral cortex. The force should be less readily dispersed in the white matter than in the cortex. This hypothesis should be subjected to experimental study.

LYNN JOHNSEN, M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Chandy, J.: The Use of Heterogenous Fascial Grafts in the Radical Operation for Hernias. *Ann. Surg.*, 1945, 122: 885

The author apparently prepares his own deep fascia of an ox or cow, and uses white cotton No. 40 for sewing the flap of fascia to protect the floor of the inguinal canal.

The preserved ox fascia, which measures about 2 by 1.5 inches, is dried of alcohol between gauze, and placed on the area. One long border of the fascial graft is sutured to Poupart's ligament by 4 interrupted sutures. The lower corner is sutured to Cooper's ligament and the inferior border is fastened to the periosteum of the pubic bone, taking care to include a good part of the periosteum. A slit about one half inch in length is made on the upper border of the graft, and the cord is passed through this opening. A suture is passed through the falx inguinalis, while the muscle is being lifted by a retractor, continued through both corners of the slit ends of the graft, carried back through the muscle, and tied. The fascial graft is thus anchored under the falx inguinalis, with allowance for passage of the cord. Two sutures are used to anchor the fascia under the conjoined tendon, and 2 to secure the fascia under the rectus sheath on the medial side. Sometimes it may be necessary to slit a part of the rectus sheath to insert the fascial graft under that muscle. Now, the fascia is well anchored to Poupart's ligament, the pubic tubercle, and under and to the falx inguinalis and rectus sheath, the cord passing through a narrow slit in the fascia.

The cut edges of the external oblique aponeurosis are next sutured, and the wound is closed by interrupted sutures.

The work of Hass on the use of preserved ox fascia in the living dog has been extended to patients. Especially prepared ox fascia appears to heal solidly in human tissue.

Experience with 158 cases, and follow-up observations on a series of 53 employees of a firm providing routine medical examinations at monthly intervals, are presented. There were no recurrences in the latter group after periods of observation ranging from 10 months to 4 years; and no recurrences were reported in the remaining 105 patients.

JOSEPH GASTER, M.D.

GASTROINTESTINAL TRACT

Somervell, T. H.: Physiological Gastrectomy. *Brit. J. Surg.*, 1945, 33: 146.

The author has been replacing the extensive operation of partial gastrectomy by the more modest procedure of ligating the arterial supply of the stomach, with good immediate results. The operation of vascular ligature has been done in 400 cases, 160 of which have been studied by test meals before, and 3 weeks after operation, and 82 of which have had a late follow-up, including the performance of a fractional test meal and a thorough clinical examination. In 380 cases of arterial ligature with or without gastroenterostomy, only 1 death could be traced. The minimal operative risk and satisfactory late results of the simpler operation are believed to give the procedure a claim to superiority. In all cases in which the total acidity of the fasting juice is above 60, gastroenterostomy combined with ligature of the arterial supply of the stomach is carried out, except in the cases of patients with gastric ulcer as well as a duodenal ulcer, or those in whom malignancy is suspected.

The operation of tying the arteries, in its simplest form, consists of firmly ligating with fine silk about 5 of every 6 of the small branches which run from the gastroepiploic artery to the stomach wall as far up the greater curvature as possible without pulling at the stomach. The sheaf of vessels on the lesser curvature is ligated *in toto*. The arteries at the pylorus and within an inch of it need not be tied. The posterior wall of the stomach is then gently pulled through the opening in the mesocolon and it is usually found that further ligations must be done to bring the number of ligated vessels up to approximately five-sixths of the total number. Gastrojejunostomy is then performed.

When the arteries are tied in this way the usual effect is an immediate and considerable drop in the acidity of the stomach. A hyperacid stomach becomes one which secretes less than the normal amount of acid. Control studies were made by testing pre- and postoperative acidities in cases of arterial ligature without gastroenterostomy, and in cases of gastroenterostomy without arterial ligature. The results of these studies indicate that the reduction of acidity is due to the ligation of the arteries and not to the gastroenterostomy.

Fractional test meals were done in 82 cases from 6 months to 6 years after operation. It was found that the lowering of acidity persists for at least 5 years, and the late results showed very satisfactory figures both for the acidity of the fasting juice and for the average total acidity during the 2 hours or so after the meal was given. In cases in which the operation of arterial ligature alone was done, without gastroenterostomy, the early and late results were exactly similar to those in which arterial ligature and gastroenterostomy were combined. With regard to the incidence of recurrent (gastrojejunal) ulcer, of the total number of 400 patients in whom this operation has been done, only 1 has returned to the hospital with a gastrojejunal ulcer. This is in contrast to the incidence of 7 cases of recurrent ulceration in a series of 300 cases in which a gastrectomy

had been done during the same period. It is believed that arterial ligation is the operation of choice in all cases of duodenal ulcer with marked hyperacidity. JOHN L. LINDQUIST, M.D.

Olsson, O.: Multiple Cancer of the Colon (Cancer coli multiplex). *Acta radiol.*, Stockh., 1945, 26: 415.

The paucity of clinically diagnosed multiple carcinomas of the colon as compared with the figures from the autopsy room suggests, of course, that many cases of multiple cancer of this region are not being diagnosed. This is of interest to the roentgenologist, who must not rest content with having established the diagnosis of a cancer of the large bowel, but should continue his examination to include the entire colon. Even though the referring surgeon be satisfied with the digital or proctoscopic findings of carcinoma of the rectum, in view of the especial frequency of the combination of rectal cancer with a second cancer in another section of the colon (this combination being found in perhaps a half of all the cases of multiple tumors of the large gut), a complete examination of the entire colon should be made, since the tumor which is overlooked in these cases may eventuate seriously.

The surgeon who refers his patient to the roentgenologist frequently merely wants the determination of the upper limits of the tumor which he already knows to be present: or he wants to know the length of the sigmoid, for the technical operative value of such determination. He may even oppose the filling of the entire bowel with the shadow producing medium. The roentgenologist, however, should not limit his quest for considerations such as these. Of course, the entire colon should not be burdened with the medium when an acute ileus is present, or in the presence of an almost impervious stenosis of the bowel lumen. However, in the latter case too much importance should not be attached to the fact that the inflowing of the contrast material in retrograde direction is difficult.

In making the decision to break off the examination short of the entire length of the colon, the preliminary roentgenogram, without contrast substance, should be carefully studied, particularly in the presence of acute ileus, or when there has been a history of attacks of acute or subacute ileus, in order to estimate if the succeeding contrast roentgenogram sufficiently explains the history, symptoms, and present findings. If then for any reason the examination remains a partial one, the surgeon should, of course, be apprised of the fact that the examination is incomplete. According to Crawfoord (*Acta chir. scand.*, 1934, 74) not less than 63 per cent of his 161 patients with an obstruction presented stenoses.

The author appends 5 case histories of multiple cancer of the colon—the rectum and anal sections are included as part of the colon—from a year's material of from 50 to 60 cancers of the colon and from 700 to 800 examinations. In only 1 of these did the roentgenologist fail to uncover the multiplicity of the condition. JOHN W. BRENNAN, M.D.

Jenkins, J. A.: Carcinoma of the Rectum, with Special Reference to Sphincteric Control. *Austral. N. Zealand J. Surg.*, 1945, 15: 15.

Radical operation for carcinoma of the rectum must continue to be the method of choice in the majority of cases for which surgery is employed. A brief description of the procedure adopted in cases in which the sphincteric mechanism can not be saved is presented. The author prefers a two stage operation.

The first stage involves exploration through a left oblique abdominal incision to determine the extent of the growth and fixity. If conservative preservation of the sphincters is decided upon, a transverse defunctioning colostomy is done. If a radical perineoabdominal excision of the rectum is not contraindicated, a terminal colostomy is performed. The pelvic colon is exteriorized and divided; the proximal stump, held by forceps, is retained in the upper angle of the wound and the lateral peritoneal passage is closed by suture; the distal stump is closed and intussuscepted into itself as far as possible, and placed in the pelvis. The abdomen is then closed.

The second stage is carried out about 3 weeks after the first stage. The perineal part of the operation is done first and completed abdominally. A "vaseline" gauze pack is introduced into the pelvic cavity and, commencing about the tenth day, is gradually removed. A catheter and tidal drainage prevent the threatening bladder infection.

The author presents case histories, and reports his observations with regard to the various conservative surgical procedures attempted, in which the sphincteric mechanism is retained. He cites the literature dealing with various conservative procedures, and the indications for their adoption in selected cases. Pathologically, various reports have modified the earlier hypothesis of the manner of spread of carcinoma of the rectum based on the work of Miles. For example, Pannett states that the rectum can be safely incised 1.5 cm. below the tumor and 2.5 cm. above. Functional results are mentioned by most writers, and all appear to be reasonably satisfied with the control achieved. However, Kirschner states that even after perfect healing, complete continence is rarely achieved because of unavoidable damage to the sphincter and to the nerves of the sacral plexus supplying it.

The author suggests a preliminary defunctioning transverse colostomy when conservative procedures are to be followed. A wider sacral exposure with consequent avoidance of splitting the posterior vaginal wall is suggested. The anorectal sphincteric ring is retained intact, as far as musculature is concerned, to avoid loss of function. The author believes that after resection of the rectum the patient must depend upon external sphincters for control, and that this control is inadequate when compared to the normal mechanism. No reference could be found in the literature as to the state of the internal sphincter muscle after operation; however, it is sup-

posed that the intrinsic nerve supply must be abolished. The normal reflex changes which influence the tone of the internal sphincter become inoperative, thereby a loss of defecation reflexes occur. There is no doubt that the involuntary nonstriped internal sphincter is important in the control of the anal sphincteric mechanism and that it possesses a continuous postural tone that varies slowly in response to reflexes from the bowel above. Although the condition of the internal sphincter has not been established after resection of the rectum, it has been thought that its tone was dependent upon the integrity of a local nerve plexus and therefore, theoretically, it is possible of recovery following injury.

Since the external sphincter plays an important part in voluntary and reflex responses to effort and in temporary control, its retention with its nerve supply is advisable. Impulses from the pelvic colon may give the patient warning of imminent action of the bowels and this action may be temporarily restrained by voluntary contraction of the sphincter and externus.

The Hochenegg pull-through operation gives the most satisfactory results in conservative surgery of the rectum in which the sphincteric mechanism is preserved. JOHN E. KARABIN, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Robertson, H. E., and Ferguson, W. J.: The Diverticula (Luschka's Crypts) of the Gall Bladder. *Arch. Path.*, Chic., 1945, 40: 312.

The peculiar outpouchings of the mucosa of the gall bladder, known as Luschka's crypts, have been so frequently described that there would appear to be nothing important that could be added to the knowledge of their morphology, pathogenesis, or complications. However, a closer study reveals so many misconceptions concerning them that an attempt to clarify their anatomic and pathological significance is fully justified.

The gall bladders studied were from two sources: 175 from postmortem examinations and 320 from surgical operations. The authors' special endeavor was to identify crypts in various normal and pathological gall bladders. Examinations were made of a sufficient portion from each specimen to afford a fairly accurate picture of the relative number and depth of the crypts that were actually present.

Among the 175 gall bladders from postmortem examinations, 112 were judged to be grossly and microscopically normal. The term "normal" is used to imply the absence of identifiable signs of any pathological condition that could influence the functions of the gall bladder materially, or could contribute clinical phenomena of disease. Of the 112 gall bladders, 65 (58 per cent) apparently contained no diverticula. Thirty-eight of the remaining 47 "normal" gall bladders revealed diverticula, grade 1, and only 9 could be graded 2 or 3. The conclusion appears justifiable that anatomically normal gall bladders contain few diverticula and they tend to remain superficially located.

The 320 gall bladders that were removed by surgical operation were from patients who presumably had definite signs or symptoms of gall bladder disease. At any rate, the proportion of those gall bladders that contained no diverticula was distinctly less than that of "normal" gall bladders removed at postmortem examination.

The extensive review of the data furnished by the work of others, and of the results of the authors' investigations, gives a perspective which appears to represent a logical solution of the several problems with which the literature has been engaged for the past 300 years or more.

The following conclusions were drawn:

1. In approximately half of all gall bladders removed from persons of more than 30 years of age, the mucosa has invaginated the underlying structures, sometimes as far as the peritoneal lining.

2. This invagination tends to form diverticular spaces with branching pouches, which occasionally simulate mucous glands. They are lined with epithelium corresponding in every respect to that which lines the mucosa of the inner surface of the gall bladder. These cells secrete mucus or a mucuslike fluid.

3. The greater number of the diverticula open into the gall bladder lumen by ducts, which are often tortuous and narrow. Some are cut off in whole or in part from the lumen and become cysts with budlike branches. When such a group is more or less localized, a formation, often called an adenoma, is produced. This is most frequently found in the fundus of the gall bladder, but may occasionally involve more, or even all, of the gall bladder wall. The term "adenoma" is misleading and inaptly applied. "Multicystic" or "multilocular cystic" diverticula are more fitting designations.

4. The crypts thus formed may contain bile, bile pigments, cholesterol crystals or, at times, typical biliary calculi. Exudative inflammation may occur in them up to the stage of abscess formation and even of rupture into the peritoneal cavity. The residuum of such inflammation may be obliteration of the epithelial lining, proliferation of connective tissue, and collections of lymphocytes and other cells.

5. Increased intracystic pressure, absence of a muscularis mucosae, a loosely, irregularly arranged muscular layer, and the independent response of the muscle bundles to physiological stimuli account for the initial diverticulalike indentations. The increased pressure is, more logically, the result of neurogenic dysfunctional states of the extrahepatic biliary system, although other mechanical factors such as stones and inflammatory obstructions may play etiological roles.

6. Except for the complexity of the branches, these crypts correspond in every other respect to the so-called false diverticula of the colon and urinary bladder; they are "diverticula of the gall bladder."

7. There is little justification, except custom, for calling them "Luschka's crypts" or "Rokitansky-Aschoff" sinuses. Not only did these investigators not possess sufficient priority but they failed in several important details to recognize the true significance of the structures that they described.

Mascheroni, H. A., Reussi, C., and Boucau, E. F.: Internal Biliary Fistulas (Las fístulas biliares internas). *Prensa med. argent.*, 1945, 32: 2397.

Internal biliary fistulas may communicate with a pregnant uterus, ovarian cysts, the pericardium, urethra, or the pleural cavity. However, in the majority of cases the fistula communicates with the duodenum, stomach, colon, or small intestine. According to one set of statistics, 67 internal biliary fistulas were found among 30,000 autopsies. Puestow encountered internal fistulas in 1.2 per cent of his patients with cholecystitis.

The main cause of internal fistula is cholelithiasis or a cancer of the gall bladder; less frequent causes are: abscess of the gall bladder, and echinococcus cysts. As to the pathogenesis, pressure by a calculus causes an ulceration of the mucosa, which leads to perivisceritis and the formation of adhesions, necrosis, and, ultimately, a fistula. Periduodenitis as a sequel of duodenal ulcer may also lead to the establishment of a communication between the gall bladder and duodenum either directly or through a fistula resulting from an abscess between both organs. A cancer of the gall bladder may invade the adjacent tissues and form fistulas, leading to the colon in a great number of cases.

No pathognomonic signs are characteristic of an acute internal biliary fistula. Puestow states that suspicion of an internal fistula is justified in patients with a hepatic colic accompanied by chills, fever, and jaundice, especially if such symptoms are frequent, persistent, or progressive.

In chronic forms dyspepsia may be the only symptom, with nausea, vomiting, and pains following errors in the diet.

Roentgenological studies are of great diagnostic value. The opaque medium may be introduced through a duodenal tube. X-ray pictures should be taken in various positions such as the supine, prone, right lateral, and Trendelenburg. The presence of gas in the biliary ducts is a rarity, but, if detected, it points to the existence of an internal fistula of the bile tract.

Involvement of the liver is a grave complication, found most frequently in fistulas leading to the colon. Inasmuch as the prognosis of an internal biliary fistula is always grave, surgical intervention should not be delayed, although the operative mortality is relatively high, reaching 19 per cent. Especially in acute forms a delay makes the prognosis poor. The fact that bile may be aspirated through a duodenal tube is of no diagnostic value and does not suggest any special time for the surgical intervention.

Persistent jaundice and the presence of white bile in the duodenal contents indicates hepatitis.

The author reports 3 cases of internal biliary fistula.

JOSEPH K. NARAT, M.D.

Itoiz, O. A.: Tumors of the Pancreas (Tumores de pancreas). *Arch. Soc. argent. anat.*, 1944, 6: 451.

The author offers the following classification of tumors of the pancreas:

A. Primary tumors: (1) benign: unilocular or multilocular cyst, cystadenoma, solid tumor, insular adenoma, angiomatous tumor, and ampullary tumor; (2) malignant: epithelioma of the head of the pancreas, epithelioma of the body or the tail of the pancreas, cystadenoma, carcinoma, malignant insular tumor, malignant ampullary tumor, and sarcoma of the pancreas.

B. Metastatic tumors, with primary neoplasm located in the stomach, spleen, left kidney, small intestine, or lymph glands.

Adenoma and malignant insular tumor produce identical symptoms.

Cystadenoma and cystadenocarcinoma have the same macroscopic aspect and only the histological examination will lead to the correct diagnosis. The differentiation of ampullary tumors of the pancreas and neoplasms originating in the lower portion of the common duct offers great difficulties.

If hydatidiform cysts, pseudocysts, and dermoids are excluded, pancreatic cysts may be divided into two groups: congenital and retention cysts.

Cancer of the pancreas forms from 1 to 2 per cent of all cancers found at autopsies. Metastases appear in relatively early stages and are found in three groups of lymph glands: subpyloric, mesenteric, and splenic. A fourth group of minor importance is found behind the pancreatic glands.

From the histological point of view, 4 types of cancer of the pancreas may be distinguished: papillary cystic carcinoma, adenocarcinoma, the medullary type, and epithelioma formed by independent cells disseminated throughout the abundant stroma. The last two mentioned forms probably derive from acini.

Sarcoma of the pancreas is extremely rare.

JOSEPH K. NARAT, M.D.

Radice, J. C., and Rivero, E.: Statistical Studies of 53 Cases of Tumors of the Pancreas (Estudio estadistico sobre cincuenta y tres casos de tumores de pancres). *Arch. Soc. argent. anat.*, 1944, 6: 489.

Of 53 tumors of the pancreas observed by the authors, 49 were primary and 4, secondary formations; 39 were found in men and 15 in women. Two-thirds of the tumors were found in patients between 50 and 60 years of age. The great majority of the patients were laborers. The largest number of tumors were located in the head of the pancreas, to be followed by that of neoplasms in the tail and the body. Married people predominated in the material observed by the authors.

In numerous instances the diagnostic difficulties were great, and cancer of the liver, tuberculosis, blood cysts of the pancreas, tumors of the mesocolon

and cancer of the biliary tract were considered. Among clinical symptoms, pain occupied the main place. Jaundice, colics of the hepatic type, a sensation of fullness, nausea, biliary vomiting, melena, and hematemesis were less frequently observed.

Among complications the following were recorded: obstruction of the biliary ducts, ascites, liver cirrhosis, fat necrosis, brown atrophy of the myocardium, and pneumonia.

The most frequent type of tumors was cancer. The malignant degeneration was accompanied by 3 histological changes: fibrosis, acidophil necrosis, and flattening of the acini. The authors confirm the observation made by other writers that glandular acini undergo rapid destruction by the cancerous tissue, while the Langerhans' islets show attempts at regeneration. In 4 cases an association of the cancer of the pancreas with diabetes was observed. In 1 case the cancer was located in the head of the pancreas; in the second, in the tail; in the third, both in the body and the tail; and in the fourth, the entire organ was invaded.

The most frequent location of metastases was the liver, to be followed in descending order of frequency by the lungs, lymph glands, and peritoneum. The largest tumor was the size of a newborn child's head.

Metastatic tumors were found nearly exclusively in the male sex, mostly in the sixth decade of life, with the location of the primary tumors in the gall bladder, biliary ducts, esophagus, and lungs.

JOSEPH K. NARAT, M.D.

Ceballos, A., Brachetto, Brian, D., and Rosenblatt, S.: Insular Adenoma of the Pancreas. The First Case in Argentina. (Adenoma insular de pancreas. Primer caso Argentino). *Arch. Soc. argent. anat.*, 1944, 6: 509.

A woman, age 37, had been complaining for 4 years of attacks of nervousness, profuse perspiration, and tremor during the preprandial periods which disappeared after the ingestion of food. Hypoglycemia, accompanied by general debility, tremor, perspiration, mental confusion, found at the clinical examination could be relieved by the ingestion of carbohydrates or an intravenous injection of glucose solution. The differential diagnosis involved a spontaneous hypoglycemia or paroxysmal manifestation of some other condition. No signs of an involvement of the liver, hypophysis, thyroid gland, suprarenal glands, or the central nervous system could be found. Therefore, an adenoma of the Langerhans' islets was suspected.

An exploratory laparotomy revealed an adenomatous nodule situated at the junction of the head and the body of the pancreas. The tumor had an ovoid shape 13 by 16 mm. in diameter; it weighed 1.55 gm., and was encapsulated. The parenchyma of the tumor had a whitish color and an adenomatous aspect. The tumor was divided by fibrous bands into alveoli. The microscopic examination disclosed two types of cells: (1) high cylindrical cells with a clear cytoplasm and irregular ovoid nuclei, and (2) low cuboid or pyramidal cells with a chromophil protoplasm and pyknotic nuclei. The latter type of cells was in the minority. JOSEPH K. NARAT, M.D.

Bianchi, A. E.: Pancreatic Insular Carcinoma (Nesidioblastoma) with Generalized Metastases (Carcinoma insular pancreatico [nesidioblastoma] con metastasis generalizadas). *Arch. Soc. argent. anat.*, 1944, 6: 497.

Since the publication of the first case of insular adenocarcinoma in 1927, numerous articles have described benign as well as malignant tumors originating in Langerhans islets. In 1938 Laidway suggested the term "nesidioblastoma" for tumors originating in the islets and the term "nesidioblastosis" for hyperplastic reactive changes of a non-neoplastic nature.

The author of this article collected from the literature 120 cases of benign tumor involving the pancreatic islets.

He observed such a tumor in a woman, age 39, who was admitted to the hospital with complaints of intensive premenstrual pains in the left scapular region, occasionally radiating to the right shoulder. The complaints were of one year's duration. The patient also had pains in the lumbar region radiating into the lower extremities. At the time of admission numerous white or bluish nodules were found scattered throughout the body. A bloody expectoration of 3 days' duration was present.

Among the important findings the following may be mentioned: the blood sugar was 117; albumin, sugar, and acetone were found in the urine; the Kahn reaction was negative; and the blood count and differential count were normal. Examination of the contents aspirated from one of the nodules revealed nondifferentiated neoplastic cells. Aspiration of the liver was done and the microscopic examination showed large cells with round nuclei and polygonal protoplasm. These cells resembled those found in the cutaneous nodules. The identification of the neoplastic cells was very difficult. Atypical mitoses were noticed. A blood examination 2 weeks after admission showed the presence of myelocytes, metamyelocytes, and normoblasts.

The febrile condition led to a fatal outcome. The autopsy revealed cystohemorrhagic formations in the liver, nephrosis, hemorrhagic ovarian cysts, hemoperitoneum, and hydrothorax on the right side. A circumscribed mass was found in the pancreas which showed a diffuse enlargement.

The histological examination disclosed a generalized endotheliosis, partially solid and partially with the characteristics of a hemorrhagic angioendotheliomatosis. Various staining methods, such as Mallory's and Van Gieson's, and thionine, allowed a diagnosis of a nesidioblastoma originating in the Langerhans' islets. The author calls attention to the fact that the blood sugar level remained normal and that numerous metastases spread through the blood as well as the lymph system.

JOSEPH K. NARAT, M.D.

MISCELLANEOUS

Etherington-Wilson, W.: Torsion of the Great Omentum. *Brit. J. Surg.*, 1945, 33: 142.

A review of the literature on torsion of the great omentum yields some 190 cases of all varieties, of which 73 can be considered of the primary or idiopathic type. The author reports 4 cases, of which 1 was primary, 2 were bipolar with a pelvic adhesion, and 1 was swollen and infected by tubercle bacilli. The 4 pathological specimens are illustrated.

The great omentum may twist as a whole, or as a part or strand; either may be complete (strangulated) or incomplete (congested); either may be primary or secondary. Primary twists are necessarily intra-abdominal and unipolar, and no definite cause can be ascertained. In cases of secondary rotation, the condition may be unipolar or bipolar, and occur as a result of hernia, adhesion, omental deformity, or past or present intraperitoneal inflammation. The condition may be acute, subacute, or recurrent. A combination of factors is probably responsible for the causation of omental torsion, such as: Peristaltic pushes by the muscle of the intestines, abdominal wall, and diaphragm; sudden jerky body actions and rotations; direct blows; omental disfigurement by tumors; overloading or uneven fat distribution; pedicle formation; scarring; raggedness; adhesions and bipolar attachments; displacement of the omentum during operation or by abdominal tumors. A history of all such causes is found among the cases recorded. A partial twist having started and caused congestion of the veins with edema, it has been suggested that the shorter and firmer arteries may complete the omental writhing. Males are more often affected than females, which may be accounted for by trauma or exertion. The condition is uncommon at the extremes of age.

The condition is rarely diagnosed or even suspected. Over 80 per cent of cases are diagnosed as appendicitis, and a much smaller number as perforated ulcers or cholecystitis. The following points are worthy of notice and should lead to the correct diagnosis on occasion: The patient, probably from 20 to 55 years of age, and a male, gives a history of right-sided abdominal pain which gradually gets worse, is often in spasms, and is usually relieved by lying down. Other symptoms and signs are not pronounced and are of little differential value. Tenderness and rigidity are not impressive. There may be a history of undue exertion or accident, and a hernial scar or sac may be present. The palpation of a doughy tumor in the midline or to the right, often above the appendix, is a suggestive sign.

The treatment consists of early exploration. The omentum, or a part, is almost always removed. Occasionally, as in one of the cases reported here, the unstrangulated omentum is simply untwisted. Apart from complications which are remote, few patients have succumbed to the abdominal condition.

JOHN L. LINDQUIST, M.D.

Eaton, R. B.: Forward Abdominal Surgery. *Canad. M. Ass. J.*, 1946, 54: 19.

The author relates his personal experiences and observations, and the lessons learned during the surgical treatment of 230 patients in a Forward Surgical Unit at an advanced Surgical Center with the R.C.A.M.C. The experience began in Normandy and ended in Northwest Germany and Holland. Twenty-one of the patients had acute abdominal lesions; all others presented battle casualties of first or second priority. There were 38 deaths.

The time interval from injury to operation, the distance, and the extent and site of the injuries are stressed as the most important factors in the outcome of the cases. In abdominal cases, the optimum time was from 6 to 8 hours, and the distance from 10 to 15 miles. The optimum time for operation after resuscitation had begun was left to the judgment of the resuscitation officers who became exceedingly skilled in their ability to determine the correct moment for surgical intervention. Pulse volume and the restoration of peripheral circulation were considered the best guides to the optimum time for surgery. Blood pressure was considered of less importance, as it was often difficult to get the blood pressure above 80 to 90 mm. Hg.; thus, a stable blood pressure plateau was of more importance than the height of a single reading. If the optimum time for surgery was missed, secondary resuscitation was usually impossible and a state of irreversible shock was likely. However, no abdominal case was considered hopeless until a laparotomy had been performed, even though the response to resuscitation was not good.

The diagnosis was usually obvious and clear cut. It consisted mainly of determining the general condition of the patient, and the number and course of his wounds. Audible peristalsis usually ruled out an intraperitoneal lesion, but flank wounds with lacerated colons were exceptions. Chest wounds produced transient abdominal signs which were confusing but which disappeared with rest and resuscitation. Exploratory laparotomy was resorted to when there was doubt as to the existence of intra-abdominal wounds.

Routine exploratory laparotomy incisions were used in most cases, but occasionally transverse incisions from the outer border of the erector spinae to the rectus muscle were used. They gave excellent exposure for flank wounds with kidney involvement, and made it possible to deal with the kidney first and then open the peritoneum to explore the peritoneal cavity. Abdominal laparotomy wounds were occasionally carried through the costal margin, which was reflected to give good exposure of the diaphragm, liver, and cardia.

The rule for the management of large bowel wounds was mobilization and exteriorization. Multiple wounds of the cecum and ascending colon required exteriorization, while less extensive ones could be sutured, and in both cases a short-circuiting iliotransverse colostomy was done. Occasionally,

wounds of the cecum and ascending colon were simply sutured and a drain inserted to the area. Spurs were feasible with left colon colostomies but gave difficulty, and, if used, should not be over 2 inches long. Multiple wounds of the colon, and pelvicolon wounds were sutured distal to a safety colostomy. Drainage was done in all cases of large bowel contamination.

Small bowel wounds were preferably sutured. Resection was necessary for multiple wounds and for wounds involving the mesentery. A single long resection was preferred to multiple short ones. End-to-end anastomosis was preferred, with a double-layer running suture and a few interrupted reinforcing sutures.

Wounds of the spleen were always treated by splenectomy. Wounds of the stomach were closed primarily, with care to watch for posterior wounds when an anterior one was found. Wounds of the pancreas carried a high mortality and were treated by suture and drainage.

Lacerations of the liver were handled by deep sutures and occasionally were reinforced by omentum, but packs were avoided. Drainage to the site of injury was considered essential.

Bladders were closed in two layers with a cystostomy, care being taken to place the suprapubic tube high in the fundus of the bladder.

Spilled intestinal contents and blood in the peritoneal cavity were carefully sucked out at the beginning of the operation. Abdominal wounds were closed in layers; interrupted chromic catgut (No. 2 or 3) sutures were used, except in the peritoneum. Sulfadiazine was used in the peritoneal cavity but its value was questionable. Sulfathiazole-penicillin powder was dusted into the wounds before closure of the skin.

The patients were kept from 10 to 12 days, and postoperative care was meticulous with adequate blood, plasma, and fluids. Penicillin (100,000 units per 24 hours) was used routinely and sulfa drugs were used when indicated.

Complications were few. Evisceration occurred in only 2 cases. Peritonitis, as it is known in civilian practice, was rare and only 1 patient was thought to have died of general peritonitis (not proven by postmortem examination). There was not a single instance of fecal fistula in this series of cases. Other complications were those usually found in extensive abdominal surgery. FREDERICK C. HOEBEL, M.D.

GYNECOLOGY

UTERUS

Masciottra, E., and Baldi, E. M.: Acute Torsion of the Fibroid Uterus (Volvulo de utero fibromatoso o torsion aguda de utero fibromatoso). *Rev. med. quir. pat. fem.*, B. Air., 1945, 13: 512.

Two cases of acute torsion of a fibroid uterus seen during 6 years on an active gynecological service are reported. The patients presented themselves with signs and symptoms of an acute gynecological abdomen, having had trouble for 6 months and 2 or more years, respectively. There were severe intermittent abdominal pain, fever, and tachycardia, but no signs of direct peritoneal involvement. A lower abdominal mass was palpable which produced pain on motion. Pelvic examination confirmed the presence of a nodular mass in the pelvis, which prevented definite palpation of the uterus. A diagnostic sign of importance is considered to be the detection of the pulse in the uterine artery anteriorly.

Both cases were considered to be torsions of the uterine body on the cervix, around the long axis of the organ. These torsions were partial as the cervix was spared in the process and incomplete because the rotation was less than 360 degrees. (The authors suggest volvulus as the diagnostic term when the cervix is not included, and axial rotation when both body and cervix are implicated). This displacement explains the anteriorly palpable pulse of the uterine artery.

Both patients were subjected to subtotal hysterectomy and made uneventful recovery.

HIRAM T. LANGSTON, M.D.

ADNEXAL AND PERIUTERINE CONDITIONS

Culiner, A.: The Relation of the Theca Cells to Disturbances of the Menstrual Cycle. *J. Obst. Gyn. Brit. Empire*, 1945, 52: 545.

The author introduces this article with a review of a previous study on the relationship between theca cells surrounding the ovarian follicles and disturbances in the menstrual cycle of the baboon. He believes that in the human being many menstrual upsets have been attributed to the presence of atretic or cystic follicles, while consideration of the accompanying masses of theca cells has been neglected.

The material from which his conclusions have been drawn for this discussion was collected from ovaries and uteri obtained at operation upon women who had complained of excessive uterine bleeding or other symptoms of endocrine disorder. There is no tabulation of the cases, but a running discussion is given in which the development and changes in the theca cells are described for the primordial follicle, corpus luteum, atretic follicle, lutein cyst, and the corpora albicans.

The author describes luteinization of the theca cells around atretic follicles in ovaries with a coexisting corpus luteum, and differentiates between the luteinized theca and granulosa cells by the presence of blood vessels in and about the cells of the theca. Such vessels were not found to permeate the granulosa cells, although in corpora lutea the vessels extended between the lobules of the cells, but not among the cells themselves. He noted an intense vascular response with capillary hemorrhage into the interstices of the theca cells as a frequently associated finding in diffuse theca luteinization.

Theca cell luteinization around atretic follicles may be without clinical significance in ovulatory cycles. The formation of extensive areas of lutein theca cells may be visible macroscopically around the follicles, but in other instances the association with the follicle may not be readily apparent. The most frequent type of change noted was one in which the cells were found to be similar to those seen as the paralutein cells of an approximately 30 day old corpus luteum. Similarity to the cells of the adrenal cortex was emphasized.

The author states that the character of the uterine reactions associated with theca cells is such that neither estrogenic nor progestational influences can be attributed to them. Their activity suggests to him a third ovarian hormone which may exert androgenic activity, or a modified secretion of the known varieties which is capable of distorting the balance between simultaneously acting steriod hormones of the menstrual cycle. GEORGE BRADBURN, M.D.

EXTERNAL GENITALIA

Novak, E., and Stevenson, R. R.: Sweat Gland Tumors of the Vulva, Benign (Hidradenoma) and Malignant (Adenocarcinoma). *Am J. Obst.*, 1945, 50: 641.

The most common location of sweat gland tumor of the vulva is on the labia majora, and the next most common is in the paralabial skin or perineum. The gross appearance of the lesion varies. It is always small, rarely reaching a size larger than that of a cherry, and usually not over 1 cm. in diameter. It may present as a small, firm, subcutaneous nodule, like a small skin fibroma, covered by intact skin. In other cases it is soft, resembling a small sebaceous cyst, for which it is commonly mistaken. Not infrequently there is a small superficial granular area on the surface. If pressure is made on the small nodule, one is apt to be surprised by the fact that, instead of a typical sebaceous exudate, the material expressed is reddish brown and pulpy. This should at once suggest the real nature of the lesion. There is no pain, and often no tenderness or soreness, especially when the skin surface is intact, and the nodule is ordinarily quite movable. In a consider-

able number of cases the patient herself has not noticed the nodule, its removal being incidental to vaginal operative procedures.

The sweat gland tumors of the vulva constitute a relatively rare but highly interesting group. Clinically they present as small and innocent looking growths on or near the vulva, but to one not familiar with their histological appearance the microscopic picture is apt to be rather startling, and perhaps lead to the diagnosis of adenocarcinoma. However, in only 1 case in the literature, that of Eichenberg, was there apparently unquestionable evidence of malignant change, both clinical and microscopic. All other cases, including the 15 cases reported herewith, were clinically benign, and all have been cured by simple excision.

Granted that the characteristic microscopic picture of these growths might well in other tissues lead to the diagnosis of adenocarcinoma, there would seem to be no justification for applying the term adenocarcinoma to these notoriously benign sweat gland tumors. It is entirely possible, and perhaps even probable, that some instances of the rare primary adenocarcinoma of the vulva may be of sweat gland origin, as in 2 cases of the group included in this article. Such an origin, however, is difficult to establish.

Fifteen cases in white women are reported, the youngest being 28 years and the oldest 67.

EDWARD L. CORNELL, M.D.

MISCELLANEOUS

Aguilera de Alvarez, M. D.: Action of the Synthetic Estrogens on the Metabolism of the Lipids (Accion de los estrogenos sinteticos sobre el metabolismo de los lipidos). *Arch. farm. bioquim.*, Tucumán, 1945, 1: 323.

This study concerns the relationship between the estrogenic hormones and the metabolism of the lipids in the mammal, and compares the results of the author with those obtained by other authors in the viviparous vertebrates. The synthetic hormones were used exclusively, since they are the easiest to obtain and their results are, in general, similar to those of the natural hormones. By the lipids the author means that heterogenous group of substances characterized by their insolubility in water and solubility in the so-called fat solvents, such as ether, chloroform, boiling alcohol, petroleum, and ether. The tissues of the experimental animals used (castrated and normal rats) were extracted with alcohol and ether according to a slightly modified method of Bloor. Total phospholipids were extracted and determined according to Fiske and Subbarow, with the photometer of Pulfrich. The choline fraction of the phophoslipids was then determined by the technique of Marenzi and Cardini (*J. Biol., Chem.*, 1943, pp. 363, 371), also the values for sphingomyelin. Finally, the values for cephalin were calculated by subtracting those of the choline phospholipids from the total phospholipids, and the lecithin was calculated by subtracting the values for sphingomyelin from the choline phospholipids. The author's determinations are given in extensive tables in the original article, and in every instance compared as a norm with the figures given by the aforecited work of Marenzi and Cardini.

In all the organs of the noncastrated animals injected with stilbestrol propionate there was a relatively marked decrease in total phospholipids, with no change in the plasma values. The lecithin showed an increase in the brain and kidney and a decrease in the heart and lung, without appreciable change in the spleen and liver; the cephalin exhibited an appreciable increase in the heart and blood plasma, but otherwise had decreased more than 90 per cent. In the normal animals injected with propionate of stilbestrol the sphingomyelin displayed an enormous decrease, to mere vestiges in some organs or even to complete disappearance.

In the castrated animals the movement of the values in every instance tended to follow those exhibited by the normal animals except that the changes tended not to be so pronounced.

When the values for the cited lipid fractions are compared with the values for total phospholipids instead of with the normal values established for noninjected animals by Marenzi and Cardini, it is seen that in normal, that is, noncastrated, animals with injections of stilbestrol, the lecithin shows a tendency to increase, while in the castrated animals, it has a tendency to decrease, the cephalin following the inverse course. Although the sphingomyelin decreases in the castrated animals, it does so in a lesser degree than in the normal animals. Castration seems to inhibit in part the effects of the stilbestrol on the phospholipids of the tissues.

JOHN W. BRENNAN, M.D.

Schaub, I. G., and Davis, J. E.: The Significance of Streptococci Isolated from the Female Urinary Tract. *Bull. Johns Hopkins Hosp.*, 1945, 77: 372.

A review of previous reports in the literature clearly shows that with the exception of alpha and gamma enterococci (often grouped as streptococcus fecalis) the relation of streptococci to infection of the urinary tract has received little attention. The present authors have determined the incidence of streptococci in a series of 9,052 consecutive cultures from catheterized urine specimens of obstetric and gynecologic patients.

The organisms were isolated and identified by accepted procedures, and classified as follows: alpha streptococci, beta streptococci, gamma streptococci, alpha and beta enterococci (streptococcus fecalis), and microaerophilic streptococci. The beta streptococci were further classified into serological groups A, B, C, and D, and "streptococcus—group not determined." This last group included organisms that had failed to react with antisera of the other four groups. It is the group A beta streptococci which are highly pathogenic for man, the cause of the acute and severe streptococcus infec-

tions, and the most frequently isolated from clinical material.

In the authors' series, streptococci occurred in 1,169 cultures, an incidence of 11.8 per cent of the total number of cultures. Of the total number of streptococci, 54 per cent were alpha and gamma enterococci, 29 per cent were alpha streptococci, 12 per cent were beta streptococci, and the small remainder were divided among the other categories. Organisms of the highly pathogenic group A beta streptococci were found in only 3 cases in the entire series. The relative incidence of these organisms, judging by their incidence in other clinical material, is the reverse of what might be expected. Therefore, the case histories of 500 gynecologic patients from whom these organisms had been isolated were studied in order to determine the pathogenicity of the various streptococci in the female urinary tract.

Streptococci were found to be the sole cause of clinical disease in 25.2 per cent of the cases reviewed, and were found to be involved with other organisms in 28.8 per cent. They were regarded as etiologically significant in 54 per cent of the cases.

The relative occurrence of the various streptococci with escherichia coli was studied and it was determined that the alpha and gamma enterococci were involved with escherichia coli in a significantly higher percentage of cases than the other streptococci, with the exception of the gamma streptococci.

In 40 per cent of the patients from whose urine streptococci were isolated, no clinical evidence of urinary tract disease could be found in the history. The authors suggest the possibility in these cases that the streptococci may have been the cause of a past disease or may be responsible for future exacerbations of urinary symptoms.

L. James Talbot, M.D.

Stoltz, H.: Malignant Tumors of the Female Genital System (Tumores malignos do aparelho genital feminino). *An. brasil. gin.*, 1945, 20: 327.

A review of the cases of malignancy of the female generative tract seen over the 10 year period from 1935 to 1945, and an account of the improvement of the facilities for conducting such work at the Clinica Ginecologica da Faculdade Nacional de Medicina of the University of Brasil in Rio de Janeiro are presented. The results are in accord with the general figures with regard to the location of the neoplasm, age, and race incidence, as well as the histopathological types and relation to the births.

On the basis of severity, these cases are classified into four groups according to the League of Nations standards. Of the cases of cancer of the cervix (224 cases), 7.3 per cent were early cases and only 32.9 per cent were in groups I and II combined.

The most frequent organ involved was the uterus. Among the 277 cases (29 recurrent lesions), including lesions of the bladder, sigmoid colon, rectum, mesentery, breast, and uterus, lesions of the uterus accounted for 234 of them, 220 being in the cervix, 4 in the cervical canal, and 10 in the body.

The treatment given is determined by the degree of invasion, the histological type, and the presence and extent of secondary infection. Surgery, radium, and roentgen therapy are used in various combinations. Some details of the irradiation technique are given.

Much improvement in diagnostic and therapeutic methods has occurred. For the first five year period the results may be given as follows: of 114 patients treated, 16 died during treatment and 31 were given only palliative therapy. Of the remaining 67, 10 or 14.9 per cent presented clinical cures after a period of 5 years.

The local socioeconomic factors influencing admission for early diagnosis, as well as the end results are discussed. Numerous detailed tables are presented showing the frequency of location of the lesions by organs; percentage distribution by degree of invasiveness in cervical lesions; frequency of the histopathological types in all organs; the age, color, and parity factors; concommitant disease incidence; the family history of neoplasia; previous surgical operations; and the frequency of various therapeutic methods which were applied.

Hiram T. Langston, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Leverton, R. M., and McMillan, T. J.: Meat for Pregnant Women. *J. Am. M. Ass.*, 1946, 130: 134.

The importance of adequate protein intake to mother and child has been well established. The investigators endeavored to see the results from the simple dietary recommendation "Eat plenty of meat—have a generous serving at least twice a day."

Private patients, all under 33 years of age, were selected. In addition to 3 regular meals per day they received 5 ounces of lean meat. Two control groups were used. All the women were about in the same stage of pregnancy and had the same hemoglobin. One group was given vitamin B complex supplement, while the other group received no supplement. These additions to the diet of meat and Vitamin B were begun early in the fifth month of pregnancy and continued for three months after delivery.

The women whose intake of protein was augmented by receiving a 5 ounce serving of meat daily had higher hemoglobin and red cell values, less edema, and more success in lactation than the women who received a supplement of B complex or those who received no supplement.

CATHERINE B. HESS, M.D.

Ware, H. H., Jr., and Winn, W. C.: Ectopic Pregnancy. *South. M. J.*, 1945, 39: 44.

The early diagnosis of ectopic gestation is dependent on the following:

1. Abdominal pain, usually unilateral, frequently described as sharp, lancinating, stabbing, or tearing, but sometimes cramplike, and usually intermittent even though dull. The pain usually has a definite onset and is frequently noticed after exertion, defecation, and sometimes after intercourse. The severity of shock is in proportion to the rapidity of onset and the amount of internal hemorrhage.

2. A careful history which reveals an irregularity of the menses, either in interval or amount and in duration of the flow. Amenorrhea for one month or more is frequent in ectopic gestation.

3. The presence of a unilateral tender boggy pelvic mass, which was diagnosed in 60 patients, or 51 per cent.

4. Manipulation or pressure on the cervix. This causes severe pain in most cases.

5. Slight bloody vaginal discharge, which was observed in 75 per cent of the patients.

6. A rapid pulse rate, associated with low hemoglobin, and a normal or slightly elevated temperature. This is very suggestive of ruptured ectopic gestation.

7. Pelvic examination. This should be extremely gentle and limited to one, if possible.

Titus says: "Expectant treatment for an ectopic pregnancy at any stage and in any location is highly hazardous, as the sac may rupture without a moment's warning and the patient die from the ensuing hemorrhage." The authors emphasize that operation for removal of an ectopic pregnancy should be done as rapidly as possible after the diagnosis is made.

CHARLES BARON, M.D.

Barnes, J., and Browne, F. J.: Blood Pressure of Relatives of Patients with Toxemia of Late Pregnancy (Preliminary Note). *J. Obst. Gyn. Brit. Empire*, 1945, 52: 559.

The authors present a preliminary report on a study which is in progress to determine what part, if any, a familial tendency toward hypertension plays in the etiology of the toxemias of pregnancy. Estimations were made on 226 blood relatives of 129 patients who had been admitted to the obstetric unit of the University College Hospital in London because of toxemia. Estimations on a control group of 66 relatives of 47 patients who were normal were also made.

There was no demonstrable difference in the blood pressure recordings between the relatives of toxemic and those of the control patients except in the group of toxemic women with essential hypertension associated with pregnancy. In this group it was perhaps significant that 16 of 18 mothers showed definite hypertension.

GEORGE BRADBURN, M.D.

Calvo, J. A.: Brow Presentation. Four Cases Observed in the Maternity Clinic in Bogota (A propósito de la presentación cefalica en posición de frente y de cuatro casos observados en la Clínica de Maternidad de Bogotá). *Rev. obst. gin.*, Caracas, 1945, 5: 146.

In 4 instances of labor in brow presentation, all in young primiparas from 20 to 26 years of age, the pregnancy had been completely normal with delivery at term of normal babies of about normal weight from 3,060 to 3,740 gm. In all, the pelvis and birth canal was without abnormality, yet the duration of labor was markedly beyond the normal for this type of presentation and no infant was delivered spontaneously. One child, however, was the only mortality.

In the first patient premature rupture of the membranes rendered manual dilatation of the cervix necessary. Attempts at conversion of the presentation into the face or vertex variety, and attempts at high forceps failed, and a dead child was delivered after 70 hours of labor by a high, laborious basiotripsy. After this amount of manipulation the patient's puerperium was naturally stormy with fever, a painful uterus, fetid lochia, and endometritis.

In the second case the membranes were ruptured after nearly 2 days of labor and the cervix was dilated to a diameter of 2 cm. However, after a further 7 hours of strong pains the head was still mobile

and dilatation had not greatly advanced; a cesarean section was done with happy results for both the mother and child.

Opposition of the relatives to a cesarean operation and the slow but relatively favorable progress in the third delivery of this series induced an expectant attitude, at least until dilatation should be complete. This decision was made at consultation 33 hours after the initiation of labor, at which the consultants insisted that delivery would occur spontaneously in a few hours. Yet 13 hours later, after 5 hours of powerful labor pains and although dilatation was complete and the head had rotated from the mentoposterior to the mentoanterior position, the membranes had not yet ruptured, and the consultants now acknowledged the necessity of interference. A difficult forceps operation resulted in the delivery of a living child.

In the fourth mother of this group the fetal head became fixed in the pelvis 16 hours after the initiation of labor and an hour later the membranes ruptured prematurely, with rapid dilatation of the cervix. Eight hours later in the presence of continuous violent labor efforts the head became fixed in the right mentoposterior position 2 finger breadths from the perineum. A relatively easy forceps operation resulted in the extraction of a living child in the mentoposterior position.

His own experiences and a perusal of the medical literature brought the author to certain conclusions, which he hopes may prove of value to the practicing physician.

These conclusions are, rather briefly, as follows:

1. Brow presentation causes grave dystocia even with a normal pelvis and small fetus.

2. Spontaneous delivery in this condition is rarely seen.

3. In the presence of concomitant complications, cesarean section is frequently an adequate procedure and the least difficult one.

4. Recourse to sedatives and antispasmotics is of great value while waiting for spontaneous delivery and while preparing for intervention.

5. The technique of procedure should be chosen according to the individual case to safeguard the life of the mother and child, the operator being guided, of course, by the following considerations: (a) a reasonable period of waiting: (b) resort to cesarean section when vaginal delivery can be anticipated to cause difficulty, and there is still time for surgery; (c) the use of forceps when the head is fixed in the pelvis, with deep anesthesia and previous episiotomy; (d) symphysiotomy if indicated: and, finally, (e) basiotripsy when the expectant period has proved a failure, or when negligence or lack of comprehension of the physician renders this disagreeable procedure obligatory.

6. Patients with brow presentation should be transferred to a specialized clinic or hospital to be cared for by a competent personnel, and where everything will be ready to cope with any complication which may arise.

7. The obstetrician should be, above everything, a good doctor and combine common sense with his technical knowledge. JOHN W. BRENNAN, M.D.

Thomas, R. C.: Rupture of the Rectus Abdominis Muscle during Pregnancy. *J.Obst.Gyn.Brit.Empire*, 1945, 52: 580.

The author reports on his second case of ruptured rectus abdominis muscle during pregnancy. The number of such cases reported in the literature is 31. Eighteen of the 31 cases gave a history of respiratory trouble, 5 occurred with the onset of labor, 2 followed a fall, and 1 case occurred after labor during the course of typhoid fever. Of the 31 patients, 3 were primagravidas, 24 multigravidas, and in 4 the parity was unknown. The treatment in 20 cases was operation; 4 of the patients died.

The difficulty in diagnosis is great, shown by the fact that in only 9 of 32 cases the correct diagnosis had been made.

The symptoms in the author's case, that of a 34 year old para-vi who was 33 weeks pregnant, were faintness, pain in the right side, and vaginal bleeding, with a history of bronchitis for 2 weeks. Examination revealed Cullen's sign, and an extremely tender uterus, most of the tenderness being above the uterus. The hemoglobin was 49 per cent. Surgery was advised and 30 ounces of fresh and old blood were removed from the whole length of the posterior aspect of the rectus muscle, extending up to the right costal margin and down to the symphysis pubis. All of the bleeding vessels were tied and the cavity was packed. Five days after the operation the patient went into labor and delivered a 3 pound 12 ounce stillborn female. CATHERINE B. HESS, M.D.

Shute, W., and Browne, F. J.: The Prevention of Premature Labor. *J. Obst. Gyn. Brit. Empire*, 1945, 52: 570.

A series of 63 cases of threatened premature labor with a resultant salvage of 73 per cent is presented. This problem is acute according to some statistics. In 1941 there were 144,692 fetal and neonatal deaths in the United States. The estimated number of premature births in the United States in 1942 was 155,000, and 33,500 of the premature infants died in the first month of life. The solution of the problem does not seem to be in saving premature infants but rather in preventing premature births.

In this study it was found that a tendency toward premature labor could usually be predicted by finding a blood estrogen excess in early pregnancy. This occurred in 87 per cent of the 38 cases tested. A blood estrogen test is made routinely at the patient's first prenatal visit. This serves as a guide to the danger ahead.

Patients developing uterine tenderness, sacral backache, spotting, loss of amniotic fluid, or a feeling of prolapse or impending menstruation are treated with Vitamin E. Only large daily doses of from 75 to 125 mgm. of alphatocopherol are effective. These and larger doses can be given throughout pregnancy

until term. This was the only therapy given with or without temporary rest in bed.

Among the 109 patients included in this and a previous report, there were 6 monsters and 92 normal living children delivered.

CATHERINE B. HESS, M.D.

LABOR AND ITS COMPLICATIONS

De Gouvea, L. R. L.: Delivery of the Transverse Presentation (O parto em apresentação córmica). *Arch. brasil. med.*, 1945, 35: 239.

This article comprises a rather complete discussion of delivery of the transverse presentation, and includes 32 references.

A brief historical review indicates that the condition was recognized even by the more primitive races and that they undertook some measures for its correction.

Consideration of the etiology, incidence, varieties, diagnostic meneuvers, clinical course, prognosis, and prophylaxis are presented in considerable detail, as are the methods of treatment.

The author's own cases, 10 in number, were seen over a 4 year period. The incidence based on a 37 month period, from June 1, 1941 to July 1, 1944, revealed transverse presentations in 0.64 per cent of 3,735 single pregnancies and in 5.3 per cent, for the second fetus, of 75 twin pregnancies. Of the 10 cases managed, 8 were single pregnancies, 1 was of twin pregnancy (second child), and 1 was an abortion. The cause for this presentation in 9 of these cases was believed to be due to failure or inability of the uterus to maintain proper control over the fetus, either because of laxity or flaccidity of the former or small size of the latter, and in 1 case it was due to multiple pregnancy.

Two cases of spontaneous delivery occurred, once by "conduplicato corpore" with a macerated 8 month, premature infant, and again by the mechanism of Douglas, in an abortion occurring in the sixth or seventh month of pregnancy. Two cases were managed entirely satisfactorily by version and extraction. Five cases, in which the fetus was dead, were managed by destructive operations—decapitation—without maternal injury. One case with ruptured uterus and peritonitis was seen; the woman had been in labor more than 48 hours because of a prolapsed hand. Laparotomy was performed but the patient succumbed. HIRAM T. LANGSTON, M.D.

MISCELLANEOUS

Gordon, C. A.: Hemorrhage as the Most Frequent Cause of Maternal Death. An Analysis of the Puerperal Deaths in Brooklyn, 1944. *Am. J. Surg.*, 1945, 70: 277.

Each year since 1938 the Brooklyn Committee on Maternal Welfare has analyzed in detail the maternal mortality. In 1944 there were 51,082 births and 62 deaths, a rate of 12.4 per 10,000; this represents a reduction of 8.1 per 10,000 over 1943.

Thirteen deaths occurred early in pregnancy; 10 from abortion and 3 from ectopic pregnancy. Toxemia was responsible for 11 deaths; 6 infants were undelivered. Infection caused the largest number of deaths—20. Cesarean section was followed by 8 deaths (6 from infection and 2 from hemorrhage). Ruptured uterus accounted for 6 deaths (3 spontaneous, 2 following version and extraction, and 1 after forceps delivery).

Hemorrhage was considered as the primary cause of death in only 8 cases and as a secondary cause in 3 more cases; however, in reviewing the cases the author states that serious hemorrhage occurred in 35 cases. He does not believe, however, that it was the primary cause of death in all instances.

Although definite improvement in the maternal mortality was noted, further advances can be made. The record of deaths from hemorrhage is proof that the precautions against death from this cause are inadequate. Blood plasma is not sufficient in replacing the lost blood; the importance of adequate amounts of whole blood cannot be overemphasized nor can delay in replacement be condoned.

J. ROBERT WILLSON, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY, AND URETER

Larsen, K.: Method for Examination of the Function of Each Kidney Separately. *Acta med. scand.*, 1945, 123: 56.

The question of function of the individual kidney is highly important to the internist. The author found that insertion of ureteral catheters for measurement of individual kidney function was too inaccurate because urine ran alongside the catheters into the bladder. He presents a formula for calculation of the function of each side, designating the amounts of urine produced by the right and left kidneys in the experimental period, respectively, as *D* and *S*, the amounts of urine collected through the right and left ureteral catheters, respectively, as *d* and *s*, and the bladder urine as *Bl*. He gives the following equation: D+S=d+s+Bl.

If the urea concentration of the urine for the right and left ureteral catheters and from the bladder is respectively *Ud*, *Us*, and *UBl*, the following equation is also true:

D×Ud+S×Us=d×Ud+S×Us+Bl×UBl.

From these equations, D and S and, afterward, the clearance from each kidney may be calculated easily. After introduction of the ureteral catheters the bladder is lavaged and emptied with a catheter after removal of the cystoscope. Then precisely 100 ml. of water are introduced into the bladder and the collection of urine from the ureteral catheters commences. At the conclusion of the experimental period the portion of the bladder content which will run freely is evacuated. After this the collection of urine from the ureteral catheters is discontinued and immediately 50 ml. of water are injected into the bladder and withdrawn immediately; after the first 10 to 15 ml. are discarded the following 10 to 15 ml. are collected for analysis. If the urea concentration of this portion is designated as *USk* and the urea concentration of the bladder as *Ubl*, that part of the bladder content that was not evacuated at once can be calculated from the equation:

X×Ubl=(X+50)×USk

Therefore the amount of bladder urine is bladder content minus 100. In the second equation the last term is replaced by bladder content in ml.×Ubl. The results are controlled in the experiments by the determination of both the urea and creatinine clearance. This method is especially suitable for unilateral kidney lesions. Error may result in patients with pronounced hydronephrosis.

DAVID ROSENBLOOM, M.D.

Rebori, F., and Magaidi, P.: Renobronchial Fistula (Fistula renobronquial). *Sem. méd.*, B. Air., 1945, 52: 956.

A woman, aged 39 years, was admitted with complaints of persistent cough and pain in the left flank. Nine years prior to admission she had had a stone removed from the left ureter, and for 1 year she had had left serofibrinous pleurisy accompanied by renal colic.

One year prior to admission she had noticed a painful tumefaction in the region of the left kidney. A physician made an incision from which malodorous pus escaped. The remaining fistula has been treated with curettage, local and oral administration of sulfanilamide, injections of prontosil, and drainage. Injections of lipiodol into the fistula did not clarify the situation. Hemorrhagic purulent expectoration and subfebrile temperature did not yield to injections of calcium gluconate.

The local examination disclosed a fistula in the left costolumbar region from which a dense purulent secretion was escaping. The urine contained a considerable amount of pus. No tubercle bacilli were found in the sputum. The sedimentation rate of the erythrocytes was accelerated. X-ray studies of the chest showed a diffuse shadow at the base of the left lung, suggestive of a pachypleuritis. Poor elimination of uroselectan injected intravenously was noticed on the left side. Ascending pyelography showed sodium bromide solution in the left lung. Prontosil injected into the fistula appeared in the sputum. Indigocarmine injected intravenously appeared in the right ureter 5 minutes later while no dye was found in the urine from the left ureter for 15 minutes after the injection.

A left nephrectomy was performed and the patient made an uneventful recovery.

The authors conclude that a renobronchial fistula, although a rare complication, should be kept in mind if a patient with symptoms of a previous renal or perirenal lesion complains of persistent cough with a purulent sputum. Nephrectomy usually cures the pulmonary process. JOSEPH K. NARAT, M.D.

Fontaine, R., Forster, E., and Ambard, D.: Extirpation of the Aortiorenal Ganglion in the Treatment of Painful Hydronephrosis (L'extirpation du ganglion aortico-rénal dans le traitement des petites hydronéphroses douloureuses). *Rev. chir.*, Par., 1945, 64: 129.

After unilateral nephrectomy, the function of the remaining kidney is improved when the aortorenal ganglion is removed. The same favorable result is obtained in cases of painful hydronephrosis. The different surgical methods are discussed.

Resection of the splanchnic nerve and resection of the superior part of the lumbar sympathetic are mentioned as alternative methods to extirpation of the ganglion. In 7 of 9 cases, the result was excellent; partial improvement was obtained in 1 case and no success in 1.

Not only does extirpation of the ganglion give definite and lasting relief to the pain and colic, but it

improves the function of the kidney at the same time. It is still an open question whether the dilatation of the renal pelvis and ureter is also favorably influenced by the operation. The treatment is causal rather than symptomatic.

WERNER M. SOLMITZ, M.D.

Cristol, D. S., Mc Donald, J. R., and Emmett, J. L.: Renal Adenomas in Hypernephromatous Kidneys; a Study of Their Incidence, Nature, and Relationship. *J. Urol., Balt.*, 1946, 55: 18.

The resemblance between renal adenoma and carcinoma has been apparent to many pathologists.

The material used in this study was derived from surgically removed kidneys which were the sites of proved Grawitz tumors. A total of 567 kidneys and contained tumors were examined. The microscopic sections studied consisted of: (1) 122 lesions suspected of being cortical adenomas, and (2) numerous sections of renal carcinomas located in the same kidneys from which proved renal cortical adenomas had been removed. The diagnosis could be verified in only 37 of the suspected renal cortical adenomas. All but one of these adenomas were largely papillary in structure. The exception was one that suggested an alveolar structure. As has been pointed out by many men writing on this subject, too often an adenoma will exhibit characteristics of more than one structural type. The largest adenoma in the series measured 4 mm. in diameter. The smallest was barely perceptible with a hand lens. More than 1 adenoma was found in 7 kidneys. The largest number of adenomas in any 1 kidney was 7. As with other investigators, this series would indicate that there is an increasing prevalence of adenomas as well as of carcinomas in the decades past middle life.

Adenomas appear in the renal cortex as single or multiple grayish white, yellow, or brown nodules. They vary in size from that which is hardly discernible through a hand lens to the size of a walnut. Many are multiple, and they are frequently found in both kidneys. Adenomas are seen to occur more frequently in kidneys containing clinical cancer than in significant series of kidneys examined at autopsy. Reasons are presented for considering adenomas as malignant growths.

Ackerman, L. V.: Mucinous Adenocarcinoma of the Pelvis of the Kidney. *J. Urol.*, Balt., 1946, 55: 36.

The case of a 66 year old man who presented a mucinous adenocarcinoma of the renal pelvis is reported; this is the first case recorded in the literature. The patient experienced attacks of renal colic at annual intervals for 14 years. Eight years previously he was diagnosed as having a giant hydronephrosis and at that time a left nephrectomy was done. The kidney showed parenchymal destruction so that it was only a few millimeters thick in many zones. The pelvis and ureter showed alteration of the lining epithelium with evidence of chronic inflammation. Some areas showed squamous metaplasia and this gradually underwent a transition to zones of piled up epithelium with vacuolated mucin containing cells which resembled morphology of the large bowel. In areas there were papillary projections similar to those seen in rectal polyps. The renal cortex showed hyalinized glomeruli and some cystic formation with flattened epithelial lining.

Six years following the nephrectomy a nonpainful swelling developed in the left flank along with abdominal enlargement which suggested intraperitoneal fluid and nodular masses. Under the left nephrectomy scar there was found an irregular mass firmly attached to the underlying structures. The urine showed much albumin with pus, bacteria, and occasional red cells. A needle biopsy of the mass showed a few cells forming acini, along with intracellular and extracellular mucin. The patient died within 6 months and the autopsy demonstrated a mucinous adenocarcinoma involving the liver, diaphragm, pleura, stomach, pancreas, and small bowel with lithiasis of the right kidney and squamous metaplasia of the pelvic epithelium. The significance of the spread is that it was not to the regional lymph nodes, but resembled that of a pseudomucinous tumor of the ovary.

The author asks the interesting question as to why the left renal pelvis underwent glandular metaplasia and the right pelvis, squamous metaplasia.

ROBERT LICH, JR., M.D.

Fish, G. W., and McLaughlin, W. L.: Liposarcoma of Kidney; Report of a Case Presenting an Unusual Syndrome. *J. Urol., Balt.*, 1946, 55: 28.

The authors report the case of a 28 year old white female with liposarcoma of the right kidney, which is the eleventh such lesion reported and the seventh so reported in an individual with the tuberous sclerosis syndrome (knobby hardening of the brain). In addition, 2 additional cases in children are mentioned: (1) that of a boy of 7 years who showed tuberous sclerosis of the brain, and (2) that of a girl of 9, presenting the classical features of tuberous sclerosis, and although death ensued of cerebral lesions an autopsy was refused.

Tuberous sclerosis is discussed briefly in the article and attention is called to the concomitant findings of greasy, gray-red lesions of the face (adenoma sebaceum) in butterfly patterns and mental deficiency coupled with convulsive seizures. The presence of renal pathology is referred to and said to consist of either a single renal lesion, although more often multiple bilateral neoplastic areas of primitive mesenchymal cell types (angio-, fibro-, endothelio-, myo-, and lipoblastomata) are found. The lesions are congenital deformities of the ectoderm and mesoderm, and demonstrate a strong hereditary factor. The individual with tuberous sclerosis seldom lives more than 20 years, and in every instance there is present the previously described skin lesion; in 80 per cent of the cases the renal neoplasm is present. In a smaller percentage there is an associated rhabdomyoma of the heart, fibromatosis,

and malformation of other organs, including the skeletal system.

The author's patient was seen repeatedly during a 4 year period. She had lesions of adenoma sebaceum and neurofibromatosis on her face, back, and left fourth toe. There was a marked cardiac systolic murmur and a large abdominal tumor on the right side. There were no other significant findings except a profound anemia. Intravenous pyelograms showed an enlarged and distorted right renal pelvis. There was no familial history of tuberous sclerosis although one sister was confined for insanity and a brother was treated for intense phobias; the patient herself was somewhat unstable emotionally.

The year before the patient was seen originally an exploratory celiotomy was done to ascertain the cause of fever, abdominal tumor, and anemia. A similar attack occurred a year later and the anemia on this occasion required the use of blood transfusions.

Three years later a similar attack of fever, abdominal tumor, and anemia confined the patient to the hospital. On this occasion the tumor seemed larger. Another attack was experienced a year later and on this occasion the hydronephrosis showed progression along with elongation of the renal pelvis and calyces, together with distortion suggesting hemorrhage. Upon nephrectomy the kidney substance was found to be almost completely replaced by various sized nodules of friable, grayish yellow tissue, with nodules at the upper pole extending behind the liver. The total weight of the kidney tumor was 1,400 grams. The tissue showed cytologically unencapsulated liposarcomas which were characteristically slow growing and nonmetastasizing, but there was local recurrence and, in addition, renal parenchymal compression.

The postoperative course was complicated by a severe transfusion reaction, but at present (2 years following nephrectomy) the patient is working and claims to have unusually good health.

ROBERT LICH, JR., M.D.

Greene, L. F., and Kearns, W. M.: Circumcaval Ureter; Report of a Case with a Consideration of the Preoperative Diagnosis and Successful Plastic Repair. *J. Urol.*, Balt., 1946, 55: 52.

The authors report a case of circumcaval ureter; this is the thirty-third case reported, the second preoperatively diagnosed, and also the second successfully repaired surgically, although it was the fifth in which such repair was attempted.

The patient was a 29 year old white male who had an attack of pain in the right costovertebral angle followed by the passage of urinary calculi a year prior to admission and then a recurrence of the pain 3 weeks before hospitalization. Excretory urography demonstrated a right hydronephrosis with dilatation of the upper third of the ureter which ended abruptly and at this point there was a gentle curve of the ureter with its convexity directed superiorly and medially; the remainder of the ureter was normal.

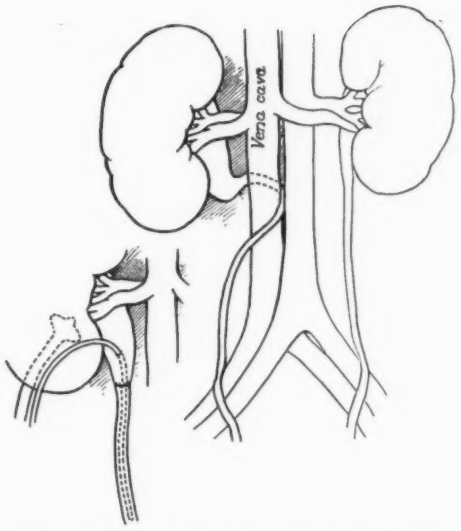


Fig. 1. Findings at operation. Surgical repair shown in inset.

The operative findings and repair are depicted in Figure 1.

The authors conclude that there is need of prolonged ureteral splinting after anastomosis of the ureter since in this case early removal of the splinting catheter was the cause of much concern, and the repeated introduction of ureteral catheters was necessary in order to reduce and finally obliterate the extravasation present at the site of anastomosis. The anastomotic site was splinted and drained for the greater part of 39 days postoperatively, and the urinary infection was controlled by the use of one of the sulfonamides. Seven months after operation, at the time this article was written, the urine was free of infection or any abnormality and the patient was asymptomatic. The kidney was almost normal, but ureteral dilatations at regular intervals were considered advisable. ROBERT LICH, JR., M.D.

Soley, P. J.: Ureteropelvic Obstructions in Children. *J. Urol.*, Balt., 1946, 55: 46.

Ureteral stricture was found once in 150 children when Campbell studied 10,000 routine autopsies. In 34 per cent of this group of children ureteropelvic obstructions were found and in 62 per cent ureterovesical obstructions. In another series of cases, studied by Campbell and Bottomly, the same relative proportion of stricture location was found; and, too, a similar distribution was found in adults. The significance of aberrant vessels in ureteropelvic obstruction is controversial, but the association of these vessels is not disputed.

The symptoms of ureteropelvic obstruction in children are pain in the back and flank, gastroin-

testinal disturbances, and the associated vesical disturbances in the presence of pyuria, including hematuria. The finding of a flank tumor is a late sign and indicative of a poor prognosis for the surgical restoration of the involved kidney. The laboratory tests for renal function were not found to portray accurately the end results following surgery. The author found that retrograde pyelography with delayed emptying more accurately demonstrated the lesion than the information obtained with intravenous urograms.

Treatment was discussed under two headings: (1) ureteral dilatations in early lesions, and (2) surgery when dilatations failed. The purpose of surgery is to relieve obstruction and the coexisting infection. Ureteropelvic obstructions are considered to be either of intrinsic or extrinsic etiology, the latter most commonly due to an aberrant vessel. The fundamentals of surgical intervention are discussed and the use of ureteral splinting catheters is emphasized.

Nineteen cases are reviewed; 10 were in males and 9 in females the ages of whom varied from 8 months to 14 years. The left and right sides were equally involved and in 5 instances bilateral obstruction was observed. Of these cases, 6 were treated by dilatation; 3 by the Foley Y operation, which was followed by improvement; 1 case was treated by severance of the aberrant vessel and nephropexy with postoperative dilatation, and a good result was obtained; 1 by a bilateral nephrostomy and the use of splinting catheters with severance of adhesions; poor results were obtained on both sides. Nephrectomy was done in 5 cases; the results were failures; heminephrectomy relieved the obstruction in the lower duct in 2 cases and left an important amount of functioning tissue in 2 cases; and 1 patient with bilateral involvement refused treatment of any kind.

ROBERT LICH, JR., M.D.

BLADDER, URETHRA, AND PENIS

Weyde, R.: The Treatment of Tumors of the Urinary Bladder. *Acta radiol.*, Stockh., 1945, 26: 589.

Weyde reports 155 cases of bladder tumors treated from 1932 to 1942 at the Norwegian Radium Hospital, Oslo, Norway. The average age of the male patients was 57.5 years and that of the women, 60.4 years. Sixty-eight patients had ulceroinfiltrating bladder carcinoma, 69 had malignant papilloma or papillomatous carcinoma, and 53 were in such poor condition that even palliation treatment was not given.

In the first 5 or 6 years after the opening of the hospital primary roentgen therapy was usually employed, although if seen at this time the patients would have received combined surgical and radiological treatment with higher roentgen doses. At this time the author administers protracted fractional irradiation to four fields, two frontal and two in back. If possible, a total dose of at least 3,500 r. is administered to each field, approximately 150 r being given daily. A total tumor dose of approximately 5,500 r. or more is given with 175 kv., 4 ma., 50 cm. FS distance, and 1 mm. Cu. filter. At present the author does cystoscopic electrocoagulation only of very small papillomatous tumors with narrow, noninfiltrated pedicles and bases. Larger tumors are coagulated openly through a cystotomy.

In young people with one or several small papillomas, cystoscopic coagulation is done and followed by careful postoperative observation. On young patients with larger and more widespread papillomas, cystotomy, coagulation, and implantation of radium needles are performed. In middle aged and older people, bladder papillomas are always treated as a carcinoma, and the author's present method consists of cystotomy, electrocoagulation of the tumor, implantation of radium needles in the wound bed, and postoperative roentgen therapy as soon as the incision is healed. The author uses 10 mgm. radium element needles in 1 mm. of platinum, from ¾ to 1 cm. apart and attached to metal wires so that they may be removed in 24 hours. After the radium implantation a roentgen dose of from 7,200 to 14,850 r., divided on four fields, is given. Widespread tumors which are not removable through a cystotomy are given primary roentgen therapy, and at times the tumor is so reduced in size that subsequent radical electrocoagulation and radium implantation can be performed. No cystectomies have been performed in this series.

The author believes that in both papilloma carcinoma and in infiltrating carcinoma, routine postoperative roentgen treatment is indicated, unless cystoscopic treatment will suffice. He has not attempted the use of the McCarthy resectoscope or of transurethral implantation of radium needles. Of the 155 patients, 111 are dead of carcinoma. Of 77 patients, 11 (14.3%) are living symptom free after 5 years and 20 (18%) are symptom free after three years.

DAVID ROSENBLOOM, M.D.

Lazarus, J. A.: Primary Malignant Tumors of the Retrovesical Region, with Special Reference to Malignant Tumors of the Seminal Vesicles; Report of a Case of Retrovesical Sarcoma. *J. Urol.*, Balt., 1946, 55: 190.

A case of primary sarcoma of the seminal vesicle is reported, with a critical review of the literature. The author states that only 3 cases of primary sarcoma of the seminal vesicle (including his own) and 20 cases of primary carcinoma of the seminal vesicle have appeared in the literature. Since carcinoma of the prostate shows a tendency to invade the seminal vesicles, the author believes that only 7 of the 20 reported cases of primary carcinoma of the seminal vesicles can reasonably be listed as authentic. In the remaining 13 cases, the prostate was involved in the malignant process and it is therefore not possible to state with certainty that the lesion originated within a seminal vesicle.

The disease is most prevalent among aged men, and the left seminal vesicle is involved slightly more

frequently than the right. Urinary symptoms ranging from increased frequency to acute urinary retention were present in approximately 50 per cent of the cases in which the symptomatology was noted in the protocols.

Metastases in the regional lymph nodes, the liver, and the lungs were reported in 12 of the 20 cases. The mortality in this group was approximately 85 per cent.

Because of the inability, in most instances, to differentiate clearly between intrinsic tumors of the seminal vesicles and the tumors designated by Young as tumors of the retrovesical space, the author believes that it is more correct to designate this group of tumors involving the seminal vesicles as primary tumors of the retrovesical space.

FREDERICK R. LIEBERTHAL, M.D.

Leadbetter, W. F.: Repair of Complete Tear of the Membranous Urethra: Case Report and Suggested Technique for Operation. *J. Urol.*, Balt., 1945, 54: 549.

During wartime, tears or ruptures of the deep urethra may be caused by penetrating wounds or fracture of the pelvis, with displacement or separation of the pubic rami. The latter is the usual mechanism producing this injury in civilian life. Because of the proximity to other structures, such as penis, bladder, and rectum, more than one organ is commonly injured. As a general rule, pelvic fractures are also associated with other injuries and the mortality is high.

The diagnosis of complete tear of the membranous urethra is simple if the possibility of it is borne in mind. There is usually slight meatus bleeding; voiding is impossible if the tear is complete; rectal examination reveals absence of the prostate from its normal position behind the symphysis. Because of bleeding, or the accumulation of urine and blood in in the space behind the symphysis, a soft mass is felt filling this region. A sound or catheter passed into the urethra will be palpated after its passage through the triangular ligament directly beneath the rectal wall. The passage of a catheter does not result in the withdrawal of urine, though occasionally some blood may appear. Once the diagnosis is made, operation as soon as possible is necessary, for the bladder will empty into the perivesical tissues.

The operation of choice is one which approximates the prostate to the triangular ligament and repairs the urethral channel. The perineal operation, if carried out as a primary procedure, accomplishes this. Generally, because of associated injuries, only a suprapubic cystostomy is possible at this time, and repair of the urethra is left for a later date.

The author presents a report of the findings and treatment in the case of a 23 year old soldier with complete division of the membranous urethra, caused by a tank accident. There was a complete tear of the membranous urethra associated with simple fracture of the pubis, as well as multiple skeletal injuries. A primary cystostomy was done. Later, it was found that the prostate had retracted after the injury, the apex having been pulled upward and pointed backward toward the rectum. The vesical neck was elevated and pushed forward. A cavity existed between the two ends of the cut urethra. Some urine was passed rectally. Perineal operation was subsequently performed. The urethra was threaded upon a catheter throughout its lumen, and the prostate was pulled down to the triangular ligament by two heavy silk traction sutures through the prostatic substance on each side of the midline, which were passed through the triangular ligament and the perineal tissues out on to the skin of the perineum toward the scrotum. The proximal urethra was similarly brought forward with silk sutures brought out to the skin.

The author proposes a new operation which would accomplish primary reposition of the prostate and satisfactory apposition of the torn ends of the urethra by the suprapubic route, possibly to be done primarily at the time of the first injury. After threading the entire urethra over a Foley catheter, the prostate is brought to the triangular ligament by silk traction sutures which are passed behind the symphysis directly through the perineal tissues laterally and through the perineal skin at the base of the scrotum. No attempt is made to repair the urethra proper. A guide of some kind should be kept in the urethra during healing until it is certain that instruments can be passed from below. This operation is suggested instead of simple cystostomy.

DAVID ROSENBLOOM, M.D.

Schourup, K.: Plastic Induration of the Penis. *Acta radiol.*, Stockh., 1945, 26: 313.

The pathology of plastic induration of the penis is obscure. It consists of the formation of a thick plaque of fibrous tissue in the tunica albuginea of the dorsum penis and is probably caused by vascular changes. Cartilage or bone is deposited in the lesion in about 10 per cent of the cases. The incidence of this condition is low (26 cases among 30,000 genitourinary patients reported by Zislin and 12 cases observed among 22,000 patients at the Radium Center in Copenhagen). The only certain fact is the association of this disease in many cases with Dupuytren's contracture which is also rare. Generally 10 per cent of the cases have been reported as having both affections. Hamann found this association in 23 per cent of his cases, and the author in 40 per cent of the cases presented in this article.

The diagnosis is rarely doubtful. Occasionally roentgenograms will help to show calcareous deposits in the wall of the penis. For the differential diagnosis, gumma, gonorrheal cavernitis, leucemia or tuberculous infiltrates and malignant tumors might be considered. They usually can be recognized by their location and the presence of ulcerations.

The medical and surgical treatment of this disease as well as methods of irradiation is discussed. The treatment of 17 cases is reported. Twelve were

irradiated with x-rays with from 300 to 2,000 r. in fractionated doses, moderate filtration, long distance and short distance arrangements varying with the case, and the testicles shielded; 3 cases underwent surgery; and 2 were both irradiated and operated upon. The results were as follows:

Group 1 Results	No. of cases
Fully satisfactory	3
Nearly satisfactory	3
Unsatisfactory	4
Not followed up	2

Groups 2 and 3 Results	No. of cases
Satisfactory	3
Less satisfactory	1
Unsatisfactory	1

The principal beneficial effect was the alleviation of pain during erection which interfered with cohabitation.

The author concludes that radiation therapy should be attempted first, the method of application being of minor importance, and only if it fails should surgery be recommended.

GERHART S. SCHWARZ, M.D.

GENITAL ORGANS

Borthwick, W. M.: Tuberculosis of the Male Genital Tract. *Glasgow M. J.*, 1945, 144: 173.

The author's discussion of tuberculosis of the male genital tract is centered mainly on epididymitis. The age incidence is essentially that of the period of greatest sexual activity. Of 402 males with tuberculous epididymitis, 88.32 per cent had at least one extragenital tuberculous lesion. He does not find that antecedent trauma or nontuberculous infection plays any significant role in the etiology of the disease. Diagnostic signs listed in increasing order of pathognomonic value are: induration, enlargement and nodularity of the epididymis; thickening of the vas deferens; involvement of the prostate and seminal vesicles; chronicity and bilaterality of the findings; and tuberculous bacilluria. In the differential diagnosis, gonorrhea, syphilis, neoplasm, nonspecific infection, epididymal cysts, trauma and torsion of the testis, and venous thrombosis of the pampiniform plexus must be excluded.

Tuberculous epididymitis was found to be bilateral in 56.47 per cent of the author's cases, involvement of the testis was found in 35.51 per cent, scrotal fistulas appeared in 41.04 per cent, and pelvic coincidental lesions were present in 87.34 per cent. Sixty per cent of the patients suffering from tuberculous epididymitis were known to have renal tuberculosis. It is believed that the prostate is the link in the chain of infection between the kidney and the epididymis, and that the organisms reach the epididymis via the lumen of the vas deferens.

The treatment of choice is surgical removal of the epididymis. When epididymectomy is performed, contralateral vasectomy is advised to prevent spread of the disease to the healthy side. The local prognosis is good, but the general prognosis is that of generalized tuberculosis and is dependent upon conservative therapeutic measures and rest.

CLARENCE V. HODGES, M.D.

Odegaard, H.: On the Treatment of Malignant Tumors of the Testis. *Acta radiol.*, Stockh., 1945, 26: 345.

In the 10 year period from 1926 to 1935, malignant tumors of the testes in Norway amounted to only 0.3 per cent of the total deaths from cancer in men. From a practical clinical standpoint, they may be divided into two main groups: (1) seminomas; (2) malignant embryonal testicular tumors. The genuine sarcoma (from the interstitial connective tissue) and the true carcinoma (from tubuli recti) are so rare that they have little significance. Malignant testicular tumors occur with equal frequency on both sides, and usually between the ages of 20 and 50.

The usual treatment today is orchidectomy with postoperative irradiation. It seems to be clear, however, from the various follow-up examinations published, that roentgen treatment of teratomas does not prolong life. On the other hand, it is beyond doubt that roentgen treatment of seminomas prolongs life. Hinman has advocated a radical operation, i.e., removal of the lumbar lymph nodes on certain indications. He is of the opinion that patients with teratomas without clinically demonstrable metastases should be subjected to radical operation, and maintains that this operation is neither difficult nor dangerous.

If, at the time of the orchidectomy, lymph node metastases are not demonstrable, it probably does not matter whether the patient receives roentgen therapy or not. In case of incipient spread to the regional lymph nodes, one may perhaps have hope of destroying these metastases. On the other hand, if the seminoma metastases have become clinically demonstrable, one must count on only a temporary improvement.

At the Norwegian Radium Hospital, from 1935 up to and including 1941, 37 cases of malignant testicular tumors have been treated. Of these, 21 were seminomas and 16 were malignant embryonal mixed tumors (teratomas). The oldest patient was 71 years of age, the youngest (with a teratoma), 1½ years. In 19 cases the right, and in 18 cases the left testis was affected. The Aschheim-Zondek test was carried out in 14 patients with seminomas (all with negative results) and in 11 patients with teratomas, (with a positive result in 1). The reaction was of no prognostic value.

Thirty-four of the 37 patients had been operated on before admission to the hospital; in 3 the condition was inoperable.

Nineteen patients with seminomas and 13 with teratomas have received adequate postoperative irradiation. Of the patients with seminomas, 11 survived and were free from recurrence for 2 years or

more, and 8 survived for 3 years or more; 2 have lived for more than 5 years. Of the patients with teratomas, 4 lived free from recurrence for 2 years or more, and 3 lived for 3 years or more. Prior to irradiation, one of the survivors for 3 years (with a teratoma) was subjected to a radical operation (Hinman's) at which time metastases of the lymph nodes were found.

Nine patients died, from metastases, within from 2 to 23 months after admission to the hospital, and from 7 to 28 months after the onset of the symptoms.

JOSEPH K. NARAT, M.D.

MISCELLANEOUS

Lazarus, J. A.: The Prevention and Treatment of Delayed Wound Healing and Ulcerative Cystitis following Surgery for Tuberculosis of the Genitourinary Tract. *J. Urol.*, Balt., 1946, 55: 160.

The incidence of genitourinary tuberculosis has greatly declined within the past two decades.

Postoperative fistula formation and wound disintegration are frequent complications following nephrectomy for tuberculosis.

The ureteral stump plays a negligible role in the production of fistulas.

Sinuses are more apt to occur in the more acute forms of tuberculosis than in the chronic. A combination of deep x-ray treatment with ultraviolet radiation immediately following nephrectomy has almost completely eliminated this disagreeable complication, and has been found to be an extremely effective method of managing sinuses which are already present.

Of the 63 cases forming the basis of this clinical study, 50.8 per cent revealed cavernous lesions of the kidneys removed; 31.8 per cent, pyonephrosis; 8 per cent, multiple abscesses; and in 9 per cent the kidneys disclosed the lesions only when sectioned. Bladder ulcerations were present in 63.8 per cent of the cases with cavernous tuberculosis of the kidney, in 45 per cent of the cases of pyonephrosis, in 100 per cent of multiple abscesses, and in 66.6 per cent of the cases in which the kidneys showed lesions only when sectioned.

The average number of x-ray treatments given to patients with cavernous tuberculosis was 16.3; with pyonephrosis, 13.6; with multiple abscesses, 19; and with kidneys showing lesions when sectioned, 16.7.

Deep roentgen therapy administered to the bladder is a distinct aid in alleviating bladder pain and in promoting the healing of tuberculous ulcerations.

It is recommended that this type of treatment start immediately after operation, since its greatest advantages are confined chiefly to the prevention of, rather than the actual treatment of, fistulas already established.

Of the newer agents for the treatment of complicating cystitis following nephrectomy for tuberculosis, the sulfonamides are highly recommended in all cases in which the urine from the bladder shows other organisms besides the mycobacterium of tuberculosis. Calcreose, a derivative of creosote, has been found helpful.

A careful course of rigid hygiene, similar to that employed in the treatment of pulmonary tuberculosis, is mandatory in the postoperative management of all cases following operation.

JOHN A. LOEF, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Summey, T. J., and Pressly, C. L.: Sarcoma Complicating Paget's Disease of Bone. *Ann. Surg.*, 1946, 123:135.

Sir James Paget, in 1852, saw the first patient with the disease which he later described as "osteitis deformans." Altogether he saw 23 cases, and his classic description of this "spongy hypertrophy of bone" is still unsurpassed. "It begins in middle age or later; is very slow in progress; and may give no other troubles than those which are due to the change of shape, size, and direction of the diseased bones; . . . . . affects most frequently the long bones of the lower extremity and the skull, and is usually symmetrical. The bones enlarge and soften, those bearing weight yield and become unnaturally curved and misshapen. The spine . . . . . may sink and seem to shorten . . . . . but the limbs, however misshapen, remain strong and fit to support the trunk." Virchow suggested leontiasis ossea as a name for the cases in which the disease is limited to the skull and facial bones.

Early in the disease, when the connective tissue has replaced much of the original bone, there is bowing of the softened weight-bearing bones. As cancellous bone is subsequently laid down in large amounts the cortices become thick and hard, and the typical mosaic pattern of lamellae develops with fibrous tissue replacing the marrow.

The cause is still unknown, but the original acceptance of a chronic inflammation tends to be replaced by the conception of some endocrine cause, the parathyroids seeming to be the most probable offender. Serum alkaline phosphate is high, but as yet no other biochemical findings contribute to a solution.

Since many cases of Paget's disease are relatively asymptomatic, the incidence rate is dependent upon the extent of the routine roentgenological studies, and may be as high as 1 in 600 patients. Eight of Paget's 23 patients died while under observation (5 of malignant lesions), and this tendency has been emphasized by many students. Sarcomatous degeneration of bones in Paget's disease is found in from 5 to 14 per cent of the patients, according to most authors. The few who question this high percentage still admit a greater incidence than in the general population.

The predisposing factor remains a moot question, but Jaffe's belief that the tremendous proliferative capacity of the tissue involved in polyostotic Paget's disease may, in itself, be the basic stimulus for tumor formation, seems most reasonable. The multiple bone involvement when viscera are spared lends further credence to this idea. The incidence of osteitis deformans is greatest in patients more than 40 years of age, with males apparently predominating among both the cases of the basic disease and those with complicating sarcoma.

To 73 cases of sarcoma complicating Paget's disease collected from the literature, the authors have added their own 3 cases. Localization of the sarcoma favors the femur, humerus, skull, and tibia, in that order, and the scapula, vertebra, and ilium next most frequently. The prognosis is grave for there is no known cure. Early amputation with or without previous roentgen therapy is the treatment of choice, and roentgen therapy alone may be palliative in the terminal stages.

The 3 new cases are presented with illustrative roentgenograms and photomicrographs, which established the diagnosis confirmed at autopsy. A complete bibliography is included.

FRANCES E. BRENNECKE, M.D.

Diez, B. R.: Chronic Tuberculous Synovitis of the Wrist (Sinovitis cronicas tuberculosas de la muñeca). *Rev. As. med. argent.*, 1945, 59: 1117.

The 2 cases reported were of the author's own personal experience, and are presented because chronic tuberculous synovitis of the wrist does not seem to have been previously reported in the Argentinian medical literature; also, several aspects of the author's experience seem worthy of special notice. The first was that of a robust officer of the maritime service, in whom the bursae of all the tendons on the dorsal and lateral aspects of the left wrist had become progressively involved in a painless swelling with fluctuation and "rice grain sensation" following a blow over this point 5 years previously. The second case was that of a woman of 22 years with a similar history, except that there was no known trauma and the process involved both wrists. In her case the duration of the condition was 3 years.

The operation was essentially under Kulenkamp's brachial plexus anesthesia in the first case, and under nerve trunk and peripheral infiltration with novocain (1%) in the second. An incision was made down the middle of the back of the wrist, and skin flaps were held back on each side; the posterior annular ligament of the wrist (ligamentum carpi dorsale) was incised, with apparently a separate incision made directly into each osteofibrous compartment. Each bursa was carefully dissected free down to its attachment to the tendon itself.

In loosening the bursa from the ligament, that portion of the latter which seems badly diseased may be cut away with the bursa, to leave only sufficient tendon substance to assure continuity, or if the ligament has lost its continuity it may be reunited by a suture or by tendon transplantation; it will usually reconstruct itself. An attempt may be made to reconstruct the osteofibrous compartment, although this again seems to be optional as the posterior annular

ligament also shows a tendency to reconstitute itself. The wound surfaces were powdered with iodoform and the skin was sutured, to leave merely filiform drainage. The part was put up on a posterior plaster splint for from 8 days to 2 weeks when the stitches and drain were removed and the splint was reapplied, with, however, daily sessions of mobilization of the fingers.

Rich and abundant food, vitamins, and calcium were provided, and in the second case the condition of the other wrist improved so much following the operation that the projected operation for this wrist was not required.

The author's experience gives one the impression that the lesion reported might be susceptible to tuberculin therapy. JOHN W. BRENNAN, M.D.

Kjelland, P. M.: A Rare Anomaly in the Elbow. *Acta radiol.*, Stockh. 1945, 26: 491.

The author presents two cases of patella of the elbow joint.

The first case was that of a washer woman, 51 years of age. She suffered two minor injuries to the left elbow, one when a small child and the other at the age of 40, neither of which was treated medically. She also had rheumatism for many years, but without particular localization to the left elbow. The recent study was brought about by a slight injury to the left elbow 4 days prior to the examination.

Roentgenograms of the left elbow in various views and under different angles revealed what appeared to be a patella of the elbow joint. Under fluoroscopic control this accessory bone was found to move with the olecranon from maximum flexion to the midposition, then from the midposition to maximum extension. The upper pole moved forward and finally came to rest with the axis of the patella perpendicular to the axis of the ulna (Fig. 1). Injection of the elbow joint with 20 per cent perabrodil revealed that the contrast medium entered between the olecranon and the anterior aspect of the patella, which seemingly was covered with cartilage. In addition, there was evidence in this case of arthrosis deformans.

The second case, that of a 73 year old man without a history of previous injury, arrived for examination because of rheumatic pain in the left elbow over a period of several years. Roentgenograms revealed a chestnut shaped accessory bone with a slight concave anterior surface just above the olecranon which was thought to represent a patella of the elbow.

In connection with these 2 cases, the author reviewed the medical literature. He was able to collect 15 additional cases. In 11 the diagnosis appeared certain, in the remaining 4, doubtful. In the majority the extension of the elbow was impaired, and during movement the bone turned into the fossa of the olecranon as if there was a joint between the posterior surface of the olecranon and the anterior surface of the patella. The posterior surface of the patella serves as a place of attachment for the triceps ligament. Several of the cases reviewed showed, in addition, characteristic changes of arthrosis deformans. It must, therefore, be assumed that elbow joints with patellae are predisposed for this affection. Otherwise the symptoms are few, and patients afflicted with it are able to work.

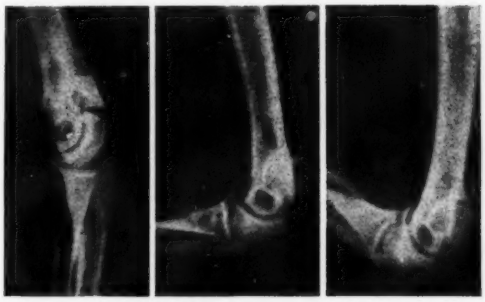


Fig. 1. Patella cubiti. The dorsal surface where the triceps ligament is attached, the smooth anterior surface which is probably covered with cartilage. Arthrosis deformans, 3 different phases of the joint movement.

The etiology is not altogether clear. The author prefers to assume an embryonic origin for several reasons. It is known that the olecranon sometimes has two points of ossification: one of these develops into the olecranon process of the ulna and the other into an accessory olecranon. By the same mechanism the second point of ossification may develop into a patella of the elbow joint. The origin from a pseudarthrotically healed olecranon fracture, as advocated by others, is contradicted by the fact that in only 2 of the reviewed cases was there evidence of definite trauma. Moreover, in 4 cases the condition occurred bilaterally and in 1 instance it was found in father and son. Finally, there is ample proof that patella of the elbow joint is encountered in the animal kingdom, as, for example, in frogs and lizards, in birds, bats, insect eaters, rodents, and one of the edentates. T. LEUCUTIA, M.D.

Lapidus, P. W.: Spastic Flatfoot. *J. Bone Surg.*, 1946, 28: 126.

Painful so-called spastic, rigid, or contracted flatfoot is a clinical entity vaguely described in most textbooks. Most investigators have believed that the condition is an advanced phase of flaccid flatfoot wherein faulty mechanics set up a reflex spasm of the pronators because of irritation in the subtalar region.

A review of the literature presents no more apt conclusions than those voiced by Todd, who offers "a concise summary of the present state of our ignorance" and agrees with the present author's belief that treatment of the spasm alone is not rational. Spasm is not the disease but the result of the disease, and manipulation with immobilization in varus is not physiological, the valgus possibly being a position of rest for the involved joints.

It is generally agreed that the condition is painful, with spasm limited to the pronator group. Trauma or occupational strain is noted appreciably often. The onset frequently occurs during adolescence. The incidence is slight compared to the large number of flaccid flatfeet seen. There are various interpretations of the facts that pes planus is not always present and that a normal or even cavus condition of the longitudinal arch may concur. Tenderness has been noted both on the lateral and medial aspects of the foot. The role of arthritis of the subtalar joint is variable.

The author presents the anatomy and mechanics of the subtalar joint graphically, and gives a logical explanation for the pronator spasm. Any lesion of the interosseous talocalcaneal ligament, regardless of etiology, may induce the syndrome appropriately called "spastic subtalar lesion." The subtalar joint surfaces may or may not be involved, and pes planus is not necessarily a part of the syndrome.

The author classifies cases of the disorder according to the extent of the pathological changes, and outlines the treatment appropriate for each type. Drastic procedures aimed at the elimination of pronator spasm are unsound and often dangerous.

FRANCES E. BRENNECKE, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Higgs, S. L.: The Use of Cancellous Chips in Bone Grafting. *J. Bone Surg.*, 1946, 28: 15.

Seventy-one consecutive cases of bone grafting were reviewed by the author, 60 of which were operations for nonunion of the long bones. Among the latter group, cortical grafts alone were used in 20 cases and cortical grafts plus cancellous chips were used in 40 cases. All of the operations resulted in union, although in 4 patients reoperation was required.

The 11 other cases were osteoclastomas, solitary cysts and osteitis fibrosa cystica, and arthrodeses, in all of which cancellous chips were used to fill the bone defects.

For successful use of cancellous chips, rigid fixation is necessary. The author has used a screwed-on onlay graft for the humerus, an onlay or inlay for the radius and ulna, a sliding inlay or onlay from the other leg for the tibia, and a screwed-on onlay graft for the femur.

Sclerosed bone must be removed, as well as all scarred and fibrous tissue. Bare muscles should be brought in contact with the bone whenever possible. Skin grafting may be necessary.

Despite the fact that many of the cases had recently been septic, bone grafting was done. Penicillin and sulfanilamide powder were applied.

Bone chips hasten the time of union by approximately 50 per cent. The chips with cortical grafts aid in filling gaps in the long bones and defects in cysts, and in filling gaps and crevices in arthrodesing operations.

DANIEL H. LEVINTHAL, M.D.

Ernst, J.: Canalization of the Femoral Epiphysis According to Duvernay (Le forage de l'epiphyse fémorale de Duvernay). *Acta radiol.*, Stockh., 1945, 26: 76.

Duvernay popularized drilling of the femoral epiphysis as the method of treating arthrosis of the hip. For this purpose he uses a drill 6 mm. in diameter, which makes a channel through the femoral neck and head.

Contradictory opinions regarding the mode of action of the operation have been advanced by various authors. Some claim that the procedure is followed by a diminution of the hyperemia which is responsible for rarefaction of the bone. This hypothesis is based on oscillometric measurements which show larger excursions before, than after the operation. Others maintain that the hyperemia following the operation produces granulations of the bony structures. This result is compared with the sequelae of drilling the bone in cases of pseudarthrosis.

Results of the operation reported by various authors differ to a great extent. This may be due to variations in the length of observation or to differences in the pathological conditions. From the anatomopathological point of view some writers differentiate two types of arthrosis of the hips: (1) the sclero-osteophytic type in which sclerotic bone tissue and cysts are found (this type has a slow evolution, and limitation of motion is more pronounced than pain); (2) the type which is characterized by atrophic alterations and rarefaction. In the latter type osteophytic formations are soft, and the osseous rarefaction and formation of cysts are marked. The cysts, contrary to those in the first type, are not surrounded by sclerotic tissue; they are soft and compressible. The lesions develop rapidly and cause much pain. This type of arthrosis yields the best results after drilling.

The author performed canalization of the femoral epiphysis 41 times in 39 patients, 2 of whom were treated on both sides. The drill used was 5 mm. in diameter. In the majority of the cases several canals, up to 8, were drilled, the average number being 3 or 4. Of the 41 operations, 19 were done in women and 22 in men. The lesion was present on the right side in 25 instances and on the left side in 16. The ages of 19 patients ranged from 51 to 60 years; of 11, from 61 to 70 years; of 6, from 41 to 50 years; of 3, from 31 to 40 years; and of 2, from 71 to 80 years. The duration of symptoms in 5 of the patients exceeded 5 years. In 33 cases the condition was primary, idiopathic, and in 8 it was secondary, following a contusion of the hip, fracture of the femoral neck, congenital dislocation, or coxa vara.

As to the complications, 2 patients developed a hematoma, 2 developed phlebitis, 1 pneumonia, and 1 paresis of the peroneus muscle. In 4 patients a tenotomy of the adductor muscle was performed immediately following the drilling or a few days later.

A follow up of 6 months after the operation showed the condition to be improved in 76.4 per cent and

unchanged in 23.6 per cent; the respective figures after two years were 70.1 and 29.9 per cent, and after six years 64.3 and 35.7 per cent, respectively. After six years 53.6 per cent of the patients had no pain at all, while in the remaining 9.7 per cent of improved cases the amelioration was partial as far as pain and limitation of motion were concerned.

In cases favorably influenced by the operation the cysts and osseous rarefaction subsided to a great extent, being replaced by a solid tissue, while in cases in which failure was recorded, sometimes an increase of the number of cysts and rarefaction of bone were found. The operation apparently was not followed by a diminution of the osteophytic formation or decrease of deformity of the femoral head in either group. JOSEPH K. NARAT, M.D.

FRACTURES AND DISLOCATIONS

De Luca, G., and Farina, M. G.: The Treatment of Compound Fracture and the Closed Plaster Method (La cura delle fratture esposte ed il metodo degli apparecchi gessati chiusi). *Policlin.* (*sez. prat.*), 1945, 52:, 402.

The closed plaster method used by the authors in both civilian and military practice for compound fracture is essentially that developed by Orr and later by Trueta, the circular plaster cast being applied directly to the skin according to the principles laid down by Boehler following the first World War.

In the authors' own material, consisting of 1,886 open fractures, 151 cases occurred in civilian life and 1,735 were due to war. The closed plaster method was used in 137 civilians (90 per cent), and in 1,320 soldiers (76 per cent). In civilian practice good results were obtained with this method in 78 per cent of cases, mediocre results in 10 per cent, and poor results in 11 per cent; in military practice good results were obtained in 73 per cent, mediocre results in 12 per cent, and poor results in 15 per cent. However, the slightly higher percentage of unsatisfactory results in military practice is not a fair comparison because of the higher percentage of serious fractures; for instance, there were four times as many leg fractures as those of the femur in civilian patients, while in the military material, fractures of the femur predominated markedly. Primary soft tissue suture could be done in 112 of the civilian patients, but was not attempted in the war material. In civilian practice there was not 1 instance of gas gangrene or of tetanus, while there was a single example of each in the war material.

The case with tetanus, an open fracture of the lower third of the right leg, was of especial interest in that the patient was erroneously twice given tetanus antitoxin on succeeding days immediately after the injury; on the tenth day there were clear indications of tetanus infection, which, however, disappeared under the usual therapy.

The authors' primary treatment of the wound, which they call mechanical sterilization and which they seem to distinguish from excision of the wound, consists of freeing the wound from blood clots, all foreign material, and devitalized tissues, especially muscle tissue and detached bone splinters. It is initiated—if the condition of the patient permits—under intravenous "eunarcon" anesthesia after 1 or 2 hours in order that the patient may recuperate from any initial shock; an attempt is made to bring the blood pressure to about 110/65, and diagnostic or other manipulations of the injured part are kept to the minimum. At this time an attempt should be made to appose the bone fragments before they are incased in the plaster, and even in the cleanest wound, perhaps with primary suture, sulfa drugs should often be insufflated into the wound.

The surgeon must first be assured of the vitality of the limb with extension in a Thomas or Braun splint (perhaps for a few hours at first), and close watch must be maintained at all times during the succeeding days. In fact, it may at times prove hazardous to enclose the limb of a wounded man in plaster in wartime, if he must be transported immediately, and transferred to the care of other surgeons who may not be aware of the importance of the lesion.

JOHN W. BRENNAN, M.D.

Kirby, C. K., and Fitts, W. T., Jr.: The Incidence of Complications in the Use of Transfixion Pins and Wires for Skeletal Traction. *Ann. Surg.*, 1946, 123: 27.

At a General Hospital in India, 342 transfixation pins and wires (195 Kirschner wires, 95 Steinmann pins, and 52 Roger Anderson pins) were used in the treatment of 233 fractures of the long bones. Three hundred and five pins and wires were observed during the entire period of their use and were removed at the hospital.

Among the 305 transfixtions there were 12 complications as follows: soft tissue infection without osteomyelitis or the formation of a chronic draining sinus at the site of a Steinmann pin; loosening of 4 Kirschner wires; loosening of 3 Roger Anderson pins; 2 cases of transient peroneal nerve palsy; breaking of 1 Kirschner wire; and slipping of 1 Kirschner wire bow. It is believed that the last 11 complications were avoidable, and in no case did a complication have any significant effect upon the course of treatment or the final result. The final results of treatment are not described in the article.

After an observation period of from 5 to 6 weeks, there were no complications in the 37 transfixtions in which the final result was unknown. Prophylactic oral sulfonamides were administered to approximately 60 per cent of the patients, either because the fracture was compound or because of associated injury or disease, and no infection developed in this group. Since infection occurred in only 1 of the 40 per cent of patients who had not received sulfonamides, and it is not at all certain that a sulfonamide would have prevented this infection, there is no statistical evidence that prophylactic sulfonamides played a part in preventing infection at the pin site

in this series. In no instance was a prophylactic sulfonamide used for the sole purpose of preventing infection at the pin site.

CHARLES A. WALTMAN, M.D.

Robertson, R. C., Cawley, J. J., Jr., and Faris, A.M.: The Treatment of Fracture Dislocation of the Interphalangeal Joints of the Hand. *J. Bone Surg.*, 1946, 28: 68.

Fracture dislocation of an interphalangeal joint of the hand is an uncommon injury and in the absence of adequate treatment results in severe permanent disability. Reduction is difficult to maintain by conservative methods of splinting, because of pressure necrosis of the soft tissues, and the authors recommend a method of multiple skeletal traction which they employed successfully in the treatment of 7 cases of this type.

The finger is prepared for surgery and is covered with a sterile dressing. A plaster-of-Paris cast is applied from the proximal palmar crease high onto the forearm, and a wire banjo splint is incorporated in the desired position. Under general or local anesthesia a small Kirschner wire is inserted transversely through the neck of the phalanx proximal to the dislocation, and another wire is placed transversely through the base of the phalanx distal to the dislocation. A third wire is passed transversely through the neck of the middle phalanx if the injury involves the proximal interphalangeal joint. If the distal interphalangeal joint is involved the third wire is passed transversely or vertically through the distal phalanx. A small temporary dressing is applied about each protruding wire. The wire is then cut and fashioned to form a traction bow. To each of the bows a rubber band is attached and fixed to the banjo. The involved joint is then flexed to from 20 to 30 degrees and the desired traction is applied to each band at such an angle as to secure reduction of the displacement.

In the 7 cases treated by the authors, the shortest period of traction-fixation was 21 days and the longest was 30 days. There were no operative infections, and excellent functional results were obtained. All 7 cases reported were caused by the patients being struck on the end of the extended finger by a baseball or softball. CHARLES A. WALTMAN, M.D.

Soto-Hall, R., and Horwitz, T.: Compound Fractures of the Femur. *J. Am. M. Ass.*, 1946, 130: 128.

The late results of treatment of femoral fractures are reviewed in an attempt to throw light on the etiology of such complicating factors as sepsis, nonunion, deformity, and knee stiffness. The series includes 117 compound fractures, of which 17 had been treated by early internal fixation. To obtain the proper standard for comparative study, 46 simple fractures are included, of which 24 had been treated by early internal fixation.

A very high proportion (29%) of compound fractures without internal fixation healed without sepsis. When this group is added to the 44 per cent classified as mild infections because they represented mainly soft tissue sepsis, and healed within 2 to 3 months, the whole picture presents a brilliant achievement of war surgery.

The infected fractures (27%) include many cases of extensive loss of soft and bony tissue with vascular damage in which sepsis is almost unavoidable. In cases treated by early internal fixation through an open wound, the incidence of severe sepsis was about 50 per cent higher than in patients treated without metal fixation. In the cases of most of these men, the plates or metal had to be removed. In some cases severe infection appeared to be under control for several weeks while chemotherapy was being administered; later the infection became clinically evident.

The following procedure seemed to offer the least danger for the type of fracture in which internal fixation appeared indicated:

A thorough débridement was done early, and was followed by delayed closure of the wound, from 7 to 10 days later. After the original wound had healed, in an average of 16 days, the fragments were approximated through a separate longitudinal incision and held together by metal fixation. In some types of fracture, the use of screws has given better results than the plate, probably because of less surgical trauma.

Chemotherapy included the use of penicillin or a sulfonamide compound, or both. The findings confirm the fact that modern antibacterial agents may produce excellent results in the control of infection and in the reduction of complications, but that they are impotent in the presence of tissue which has lost its blood supply and which does not allow the drug to come in contact with the infection.

Cases in which union occurred within a period of from 5 to 7 months were classified as delayed union; cases showing neither clinical nor radiological evidence of bone union beyond 7 months were classified as having reached the stage of nonunion. Considering the frequency of severe injury with comminution and absence of bone fragments, the proportion of bone union which occurred in cases treated by external splinting was extremely high, 86 per cent, and definitely higher than the finding in fractures treated by internal fixation. A comparison of the time required for union in simple fractures treated by open and by closed methods demonstrates that in spite of the improved apposition of fragments in the open cases, there was little difference in the period needed for bone healing. The state of delayed union and of nonunion appears directly related to the degree of bone loss or damage, distraction, and the presence of infection. Distraction, even of a very minimal amount, is particularly harmful.

A comparison of the results with respect to restoration of knee motion in men treated by internal fixation and in men treated by traction showed no appreciable difference. The findings were not en-

tirely conclusive because in a number of patients who had had sepsis or delayed union, the splinting had been too recent. The average period from the date of injury to the last examination was only 9½ months, so that the statistics do not indicate the final result but do describe the slowness in restoration of joint motion. Two factors which were found to be definitely helpful were the use of resistive exercises and the use of delayed closure. Successful delayed closure resulted in much earlier healing and less scarring, so that exercise and activity could be started earlier. An important disability was a limitation of extension of from 5 to 10 degrees in about one-third of the cases. This disability could be overcome after several weeks of active exercise, but its occurrence argues in favor of treatment of fractures above the lower third with the knee in full extension.

Other complications were refracture in 5 patients, and renal lithiasis in 6 patients.

The authors conclude that early and adequate débridement is the most vital factor in the successful treatment of compound wounds, and that conservative treatment of traction in balanced suspension gives extremely gratifying results.

JOHN L. LINDQUIST, M.D.

King, T.: Slowness and Failure of Bony Union after Fractures and Osteotomies of the Proximal or Trochanteric End of the Femur. *Austral. N. Zealand J. Surg.*, 1945, 15: 33.

Nonunion is very rare in extracapsular, lateral, or intertrochanteric fractures of the femoral neck, and slow union is the rule. In the past 10 years the author has seen only 2 cases of nonunion of fractures of these types. Prolonged immobilization provokes complications and difficult nursing problems which may be obviated by internal fixation by the Blount and Moore blade apparatus, the nail and plate method of Jewett or Hawley, and other similar methods. In addition, more rapid osseous union results because of good reduction, firm apposition of the fractured surfaces, and absolute immobilization. The Stader or any other form of splinting which requires that the bones be transfixed by ¼ inch nails above and below the fracture site and attached to some form of external holding apparatus is considered too dangerous because of the infection along the pins that must inevitably occur in a certain proportion of cases.

Fractures at the base of the neck and between the tip of the greater trochanter and lesser trochanter can be treated with the Smith-Petersen nail and no supplementary plate is required. When the fracture is situated distal to the level of the lesser trochanter a plate is attached to the Smith-Petersen nail. In the reduction of fractures of this type, coxa vara should be overcome on the orthopedic table by traction and abduction, but the external rotation that is present in most cases should not be corrected by internal rotation of the limb, as is carried out in intracapsular fractures. Accurate reduction is obtained by allowing the limb distal to the fracture to remain externally rotated about 45 degrees from the vertical plane and thereafter correcting any differences in the angles of rotation between the fractured fragments by pulling forward the trochanteric fragment with a sharp hook. When the nail is introduced the angle of declination is forward from 25 to 15 degrees instead of backward. At least 1 to 1½ inches of the head end of the nail should stand out before the plate is attached, as it will be impossible to attach the plate if the nail is driven all the way in. A modified Hawley plate with a reamed ring is used and is attached to the tapered head of the nail. It provides a strong fitting especially when fixed down by the screw. When the angle between the plate and reamed ring is to be altered so the plate is parallel with the femoral shaft another taper headed nail should be used for the adjustment while the plate is held in a sterile towel. Levers, pliers, or vises should not be used to alter this angle as they may convert the absolute circle of the reamed ring into a slight ellipse and thereafter it will not be possible to attach the ring to the tapered nail head.

Seven cases of nonunion among 120 subtrochanteric osteotomies are reported and summarized according to Table I. Three cases were treated by bone grafting. The pelvis is raised 6 inches from the operating table with sand bags. At least half of the iliac crest and adjacent ilium should be removed to obtain a sufficient amount of bone for packing the ununited bone area. The site of nonunion is approached by an incision that is somewhat more anterior than the usual lateral one. After the bone is exposed by cutting through the tensor fascia femoris and vastus lateralis muscles, a curved lever is placed medial to the femoral shaft and just below the base of the calcar femorale in the region of the lesser trochanter. Thereby the nonunion area is seen from the front. A ½ inch gouge is used to cut a gutter in the bone proximal and distal to the ununited area and this gutter should be as large as possible. The gouge is driven deeply into both fragments so that bleeding cancellous bone is exposed. The fresh bone obtained from the ilium is chopped into small pieces no larger than maize. The chopped up bone is hammered into the medullary cavities of both fragments of the nonunited bone with the blunt and round head of a chisel until it forms a paste. After that the bone is packed in front and to the lateral side. Finally, any respectable looking bone that had been cut out of the ununited area for providing the gutter is chopped up into chips about the size of wheat grains and inserted. When the wound is closed a bulge should be evident on the surface, indicating that a large mass of bone grafting material lies underneath. Immobilization is done by means of plaster spica or with the sling and traction. All 3 patients operated upon obtained sound osseous union.

The method was also used successfully in the treatment of a patient with nonunion following a fracture of the upper femoral shaft, a trochanteric fracture.

TABLE I.— ANALYSIS OF SEVEN PATIENTS WITH NONUNION OUT OF ONE HUNDRED AND TWENTY SUBTROCHANTERIC OSTEOTOMIES

No.	Reason for Osteotomy	Age	Type	Post-operative Splinting	Treatment of Nonunion by Bone Grafting	Splinting after Bone Grafting	Result of Bone Grafting
1	Osteoarthritis	63	Lorenz - McMurray 15/10/40	Sling and traction.	None	—	—
2	Osteoarthritis	45	Schanz 12/3/41	Large spica	None	—	—
3	Osteoarthritis	53	Schanz 28/11/41	Sling and traction	19/8/42	Large spica	Osseous union
4	Nonunion of fractured neck femur	49	Lorenz - McMurray 6/12/41	Sling and traction	None	—	—
5	Nonunion nailed fractured neck femur	55	Lorenz - McMurray 5/5/43	Large spica	None	—	—
6	Osteoarthritis	45	Lorenz - McMurray 7/7/43	Large spica	30/7/44	Sling and traction	Osseous union
7	Congenital dislocation of hip	35	Schanz 25/8/43	Sling and traction	19/4/44	Large spica	Osseous union

(1) Ninety patients were immobilized by sling and traction, and 30 in large plaster spicas. (2) There were 7 patients with nonunion and 4 of them had been immobilized by sling and traction and 3 by plaster spicas. (3) Three of the 7 patients with nonunion were operated upon by bone grafting, and osseous union resulted.

In the presence of infection an advantage of this type of bone graft is claimed over the tibial twin saw bar of bone because the entire graft is not prone to be lost. Case 6 had a sinus which could not be cleared up. It was excised at the operation and the spongiosa graft was employed. Infection supervened, but osseous union resulted after 6 months. When spongiosa graft for nonunion is combined with nailing and plating, the nail and plate are attached first. The front aspect of the femur is guttered at the fracture site and not on the lateral aspect. A complete freeing of the two ununited ends is unnecessary. It takes too long and is harmful because it results in a disturbance of the blood supply.

Internal fixation of the osteotomized fragments after subtrochanteric osteotomy by nailing and plating eliminates external splinting and the patient may be ambulant, or at least free to move around in bed. Before the operation, the exact site, line, and angle of the osteotomy must be planned because of the bends and angles that must be made in the plate to conform to the osteotomy. These details are worked out with paper models made from tracings of the x-rays. The plate is bent by the surgical maker to the shape required because the steel must be heated for bending. The plating of a Lorenz-McMurray osteotomy is fairly easy if the plate is bent beforehand and the osteotomy is performed to plan; but the Schanz operation is more difficult unless the upper fragment can be hooked down into the adducted position. If it cannot, then the leg must be fully abducted below the site of osteotomy which will make the application of the plate rather difficult.

Primary subtrochanteric osteotomy has been substituted by some surgeons for nailing of intracapsular fractures of the femoral neck to eliminate nonunion or traumatic arthritis because it is the method of treating these complications should they occur. The author suggests combining nailing and plating with primary subtrochanteric osteotomy if the fracture is more than 3 weeks old, the bone is comminuted, or the patient is a young manual laborer. No cases utilizing this form of treatment are reported.

This article is well illustrated with diagrams and x-rays. A short bibliography is appended.

CHARLES A. WALTMAN, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Ross, J. P.: The Surgery of Arterial Disease and Injury. *Brit. M. J.*, 1946, 1: 1.

Vasospastic phenomena are seen in a variety of conditions but true Raynaud's disease is a clinical entity. It is characterized by color changes in the digits produced by cold and occurring in attacks which show a rapid onset and recovery; the extremities are affected symetrically. The peripheral pulses are preserved, and if there is any loss of tissue it is never more than a shallow ulceration close to the fingertips; true gangrene is extremely rare. The condition is almost exclusively limited to females, is not commonly excited by emotion, and is not usually associated with excessive sweating. The author agrees with Lewis that it is due to abnormal sensitivity to local cooling of the small arteries.

In an attack the lumen of the digital arteries is almost completely obliterated. The value of sympathetic denervation is that the lumen of the vessels is permanently increased so that a cold stimulus, while reducing it greatly, does not arrest the circulation completely. Since sympathectomy should be complete for satisfactory results, the author favors the posterior approach of Smithwick and White for the upper thoracic chain. With the anterior approach of Telford there is greater danger of sparing anatomically abnormal filaments. For the lower extremity removal of the second, third, and fourth lumbar ganglia is the usual procedure.

While there are many different causes of obliterative arteritis, it is the level of the block in the arterial tree, not the cause, which determines the clinical picture and the value of sympathectomy in its treatment. Three clinical groups may be recognized. In one, a main vessel, such as the femoral or popliteal artery, is thrombosed and the presenting symptom is intermittent claudication in the calf muscles. The nutrition of the skin of the foot remains good since an adequate collateral circulation keeps the distal vessels supplied. If the level of the block is low enough to involve the sural arteries which supply the gastrocnemii, sympathectomy is of little value for claudication. However, if the block is more proximal, sympathectomy will provide a considerable increase in the blood flow to the calf. For this reason it is important to palpate the femoral and popliteal pulses as well as those in the ankle.

Some information about the probable effect of sympathetic denervation may be obtained by temporary block of the sympathetic trunk. A good response is an argument in favor of operation. On the other hand, a poor response is not sufficient to deny the patient possible relief by sympathectomy since the postoperative improvement is gradual.

In the second clinical group the distal arteries are principally affected and the characteristic manifestations are rest pain and nutritional changes in the skin of the foot. The pulse in the main vessels may be present even at the ankle but there is an abrupt drop in the surface temperature at the level of the arterial obstruction. Sympathectomy in this group may often abolish the intense pain and permit successful local amputation of the toes if gangrene has already been established.

In the third group there is widespread narrowing of the lumen throughout the arterial tree. Sympathectomy is generally useless and amputation above the knee becomes necessary.

Fresh lacerations of the arteries should be repaired when possible, but contusions should be treated by excision of the contused segment and ligation of the companion vein. When an arteriovenous fistula follows vascular injury, quadruple ligation and excision is the usual operative procedure. Twice, in cases of popliteal aneurysmal varix, the vein was ligated above and below the fistula so that the latter could be isolated and ligated like an arterial branch. The main artery was preserved. These patients suffered from symptoms of venous obstruction afterward. Consequently, in 2 other cases the artery was ligated above and below the fistula but the vein was left intact; the results were most satisfactory in these 2 patients. Because of the abundant collateral circulation associated with arteriovenous fistulas, it is advantageous to preserve the vein when it is feasible to do so.

THEODORE B. MASSELL, M.D.

BLOOD; TRANSFUSION

Iokhveds, B. I.: Intracardiac Blood Transfusion. *Am. Rev. Soviet M.*, 1945, III: 116.

The author reports 2 cases in which a physiological solution of sodium chloride, glucose, and blood were used for restarting the intracardiac blood flow.

In the first case, the transfusion of blood through a needle inserted into the right ventricle corrected the apparent or clinical death and restored consciousness. Severe myocardial damage was probably responsible for the irreversible death that occurred 2½ hours later. It should be emphasized that in spite of the marked flabbiness of the myocardium, the needle which was present in the heart for about 15 minutes while the heart was contracting had left only a minute puncture.

In the second case, the cause of collapse and clinical death may be attributed to the profuse hemorrhage and to the rapid blood loss. A reflex shock occurred, the volume of the circulating blood decreasing even more and the flow of blood to the heart diminishing greatly. Application of massage to the heart externally and the intracardiac injection of epinephrine might be insufficient in such cases since the cause of death is not failure of the myo-

cardium, but inadequacy of the blood supply to it. The heart, even when revived, will continue to work in "vacuum," and after a few seconds or minutes will stop again. Therefore, the author decided to adopt a more physiological approach by increasing the contents of the cavities. It is known that an increase in the contents, although not maximal, is an adequate impulse to start contraction, as long as the heart is capable of responding to stimulation.

In the second case, injection of blood and salt solution into the left ventricle rather than the right was indicated for a definite reason. Insufficient contracting force of the recently revived heart and the pressure behind the injected solution would have been insufficient to overcome the resistance provided by the capillary network in the lungs and only insignificant amounts would have reached the left side of the heart. By injecting these solutions directly into the left ventricle, even the first and comparatively weak contractions of the heart re-established the blood supply to the vitally important brain centers, and thus provided an antishock effect. In addition, the increased volume output of the left ventricle independently improved the coronary blood flow.

When blood and other liquids are to be transfused into the right chamber, the needle should be inserted into the lower part of the fourth left intercostal space, one finger's breadth from the left margin of the sternum. This site will prevent injury to the intercostal neurovascular bundle and the internal mammary artery. The left ventricle will be entered when the needle is inserted in the same interspace and from 2.5 to 3.0 cm. to the left of the left margin of the sternum. JOSEPH GASTER, M.D.

De Weerdt, W.: The Influence of Sex in Transfusion Reactions (Influence du sexe sur les reactions transfusionnelles). *Rev. belge sc. méd.*, 1945, 16: 254.

Attention is directed to the role of the sex of the donor and of the recipient in the incidence of transfusion reactions. De Montis and Delhaye in 1937 found transfusion reactions in 8.7 per cent of female to female transfusions, in 8.3 per cent of male to female, in 3.9 per cent of female to male, and in 3.5 per cent of male to male. Hustin and Remy in 1942 studied 864 transfusions, and found transfusion reactions in 17.3 per cent of female to female transfusions, in 9.1 per cent of male to female, in 6.3 per cent of female to male, and in 5.3 per cent of male to male.

The author has compiled data on 666 transfusions given by the Belgian Red Cross in 1943 and has grouped them according to the sex of the donor and the recipient as follows:

	Transfusions	Reactions	Percentage
Female to female	88	28	31.8
Male to female	151	35	23.1
Female to male	190	42	22.1
Male to male	237	47	19.8
Total	666	152	22.8

When grouped as to transfusion indications (neoplasms, infections, anemias), more reactions occurred in the patients who had primary blood dyscrasias.

The author believes that more research is necessary to determine the significance of the sex of the donor and of the recipient in transfusion reactions.

C. FREDERICK KITTLE, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Croce, E. J., Schullinger, R. N., and Shearer, T. P. The Operative Treatment of Decubitus Ulcer. *Ann. Surg.*, 1946, 123: 53.

The authors present a method of primary closure of decubitus ulcers in young paraplegic casualties. Given the same back care postoperatively as the paraplegic without bed sores, the results seem to be quite as satisfactory as in patients with unbroken normal skin. The method seems to be applicable to the largest sacral ulcers. With rare exception, the results may be obtained by a single stage procedure. Careful preoperative preparation and evaluation are just as important as is the technique of the operation itself.

The operation is performed without anesthesia. Complete excision of the ulcer, including the peripheral scar tissue and the base, is essential. Curvilinear incisions are made on each side of the defect and flaps are raised sufficiently to close the excised area. This is done by rotating the flaps on each side toward each other. Fine nonabsorbable sutures are used. Postoperatively, pressure dressings are applied. Penicillin and sulfadiazine are administered when indicated. BENJAMIN GOLDMAN, M.D.

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Damrosch, D. S.: Chemoprophylaxis. *J. Am. M. Ass.*, 1946, 130: 124.

In November and December of 1944 a controlled program of chemoprophylaxis against hemolytic streptococcus infections, which were then of epidemic proportions, was employed in three small naval training schools.

In the month of November significantly fewer streptococcal infections occurred in the groups receiving sulfadiazine prophylactic treatment (in daily doses of 1 gm.) than in the control groups. During this period sulfadiazine resistant Group A beta-hemolytic streptococci were absent in one school and present only in small numbers in the other two schools. In December, however, with new trainees, there was a progressive failure to prevent streptococcal infections in the treated group. The failure was related to the increasing prevalence of strains of Group A hemolytic streptococci which showed resistance to sulfadiazine in vitro.

WALTER H. NADLER, M.D.

Ackman, D., and Smith, F.: The Role of Chemotherapy in Wounds and Surgical Infections. *Ann. Surg.*, 1946, 123: 70.

For the past 2 years the authors have been jointly engaged in a study of the effect of bacteriostatics in fresh trauma and pre-existing infections for the National Research Council of Canada. The object of this investigation has been to determine as far as possible the practical value of bacteriostatics used topically or systemically, and both prophylactically and therapeutically, in fresh trauma and pre-existing infections. The work has been done in civilian hospitals and the laboratories of McGill University. A uniform surgical technique was adapted to the individual case so that the chief variables were the type of bacteriostatic and method of application.

The following points summarize the authors' convictions:

The nature, age, and extent of any injury or infection profoundly modify the value of any antibiotic substance.

Adequate surgery is more essential in the treatment of trauma than are chemotherapeutic substances.

The mere presence of bacteria in a wound is by no means synonymous with infection.

Bacteria tend to persist in a healing wound up to the time of complete and final epithelization without clinical signs of infection.

Pyogenic streptococci regularly disappear from wounds and pre-existing infections treated with sulfonamides or penicillin. Most other wound pathogens, notably the staphylococcus pyogenes, bacillus proteus vulgaris, pseudomonas pyocyanea, and clostridium welchii, persist in the presence of chemotherapy without necessarily producing clinical infection.

Bacteria in wounds were a far greater hazard in presulfonamide days than at present, despite our inability to sterilize a wound completely.

Topically applied penicillin has not proved as effective an agent as sulfathiazole, probably because of its rapid disappearance, which makes frequent exposure of the wound necessary. Its routine systemic use in a large ward with normal personnel is much more burdensome than that of the more convenient sulfonamides.

It seems certain that bacteriostatics keep the contaminated wound from becoming an infected wound. This they probably do by prolonging the important "lag period," restraining free bacterial multiplication during this time, and allowing elaboration of the natural barrier to microbic invasion.

All this is facilitated by immobilization and occlusive compression dressings which are changed infrequently.

Hypersensitivity reaction from topically applied sulfonamides is a highly controversial issue. The authors have seen such little evidence of it with infrequent dressings that they consider the risk entirely unimportant.

There is no convincing evidence that the bacteriostatics which have been used significantly influence

the pseudomonas pyocyanea or bacillus proteus vulgaris in a wound. This remains one of the outstanding unsolved problems. Both the unreserved condemnation of bacteriostatics and their endorsement as "miracle drugs" are the results of completely uncritical judgment. The truth, as usual, lies somewhere between these two extremes. As far as trauma is concerned, the most efficient of the bacteriostatics is, at best, only an adjuvant to adequate surgery.

In chronic surgical infections, surgery is paramount. In acute localized infections, surgery and chemotherapy are interdependent. In acute spreading infections, chemotherapy is the immediate necessity. BENJAMIN GOLDMAN, M.D

Meleney, F. L., Johnson, B. A., Pulaski, E. J., and Colonna, F.: The Treatment of Mixed Infections with Penicillin. *J. Am. M. Ass.*, 1946, 130: 121.

In the treatment of surgical infections with penicillin it is of the utmost importance to have a complete picture of the bacterial flora of such infections, and to know whether the organisms present are susceptible, indifferent, or antagonistic to penicillin. Attempts should be made to eliminate aerobic gram negative, nonsporeforming bacteria, which have a destructive action, before "susceptible" species have developed resistance to penicillin.

P-chlorophenol is the most effective antibacterial agent against gram negative organisms, of the presently available antiseptics so far tested. In a concentration consistent with safe clinical application, p-chlorophenol was bacteriostatic and bacteriocidal for all the gram negative organisms tested, whereas 9-aminoacridine hydrochloride and 5 nitro, 2 furaldehyde semicarbazone were not effective against the pseudomonas pyocyanea.

The individual strain susceptibility of the gram-negative organisms isolated from any given infection should be tested for the inhibitory action of parachlorophenol, 9-aminoacridine, 5 nitro, 2 furaldehyde semicarbazone, streptothricin and streptomycin, since the sensitivity of different strains within the same species as well as the sensitivity of different species varies greatly. All of these agents are compatible with penicillin and may be combined for local application to infected wounds. They may be incorporated in a carbowax propylene glycol base for local application and prolonged action in wounds.
WALTER H. NADLER, M.D.

Leacock, A.: Penicillin for Chronic Undermining Ulceration. *Brit. M. J.*, 1945, 2: 765.

The case reported here is that of a 32 year old soldier who developed a large abscess in the left arm following an injection of T. A. B. vaccine. Despite free incision and drainage subsequent pockets occurred and had to be incised. Undermining of the edges took place with the typical zones about the edges described by Meleney. The edges were excised and the sinuses opened to give a large flat wound. Plaster immobilization for one month resulted in a gradual extension of the ulcer so that the involved area covered most of the posterior surface of the arm. Various bacteriostatics were unavailing. Zinc peroxide was not obtainable. An anaerobic hemolytic streptococcus, staphylococcus aureus, and pseudomonas pyocyanea were isolated from the wound on culture.

Seven and one-half months after the initial injection the lesion was treated with local penicillin (100 units per cubic centimeter), enough to keep the dressings wet. After 48 hours the penicillin sensitive organisms had disappeared and in 5 days improvement was marked. The pyocyanea diminished under 1 per cent acetic acid dressings. Epithelization covered more than half of the area and Thiersch grafts were applied to the remainder.

The literature is discussed, and the lesion is differentiated from postoperative cutaneous gangrene. The author believes that penicillin applied locally may be more effective than zinc peroxide and may replace it. THOMAS C. DOUGLASS, M.D.

Wie-Chang Chu: Miscellaneous Pharmacologic Actions of Citrinin. *J. Lab. Clin. M.*, 1946, 31: 72.

Citrinin is the antibiotic substance produced by the molds, penicillium citrinum, aspergillus terreus, and aspergillus candidus. It is also found in a flowering plant, the crotalaria crispata. It is an organic acid, but has not been synthesized. It is stable, and can be autoclaved at 15 pounds of pressure for 20 minutes without loss of antibiotic power. It has a fairly high antibiotic action on most gram positive bacteria, but, unfortunately, it is rather toxic for higher animals. It has been reported as useful as, though weaker than, penicillin in the local treatment of sore throat, of the common cold, and of abscesses. Nothing, however, has hitherto been reported about its local effects, possible injuriousness to the mucous membranes and skin, and its systemic effects and absorption from various regions, especially after local applications.

Proposed concentrations of citrinin sodium in sprays, lotions, and ointments for local application to the mucous membranes and the skin were not found to be demonstrably irritating or injurious; however, the slight or moderate irritation which they produced was not objectionable, as indicated by tests in animals and human beings. Concentrations higher than those proposed caused definite protoplasmic irritation or injury, but this was temporary and readily reversible.

Systemic absorption of citrinin, in animals receiving high concentrations and doses by instillation into the nose or mouth, is practically negligible. Blood concentrations of from 1:4,000 to 1:32,000 citrinin were demonstrable after the introduction of high doses of citrinin into the ligated esophagus and stomach and all portions of the intestine of rats, and also after intramuscular injection.

Rapid intravenous injections of citrinin, in doses of from 10 to 100 mgm. per kilogram, caused immediate, though temporary, depressor effects, which

increased with the dosage; this was due, presumably, partly to direct cardiac depression, and partly to peripheral vasodilatation. The highest doses used could produce dangerous sustained depression. Slow intravenous injections of citrinin, however, had no such effect. A reversal of the depressor to pressor action occurred in atropinized animals.

The average bacteriostatic concentrations of citrinin in broth were 1:16,000 for the staphylococcus aureus, and 1:40,000 for the streptococcus hemolyticus. The antibacterial action was unaffected by human serum, increased by fresh human urine, and decreased by heated urine. Experimental staphylococcic infection in mice was not prevented with high doses (one-half the toxic) given intraperitoneally.

SAMUEL KAHN, M.D.

Olson, C. T.: The Use of Tantalum Oxide, Type 400, in the Treatment of Wounds. *Indust. M.*, 1945, 14: 949.

This article is a preliminary report of the author's experience with the use of tantalum oxide, type 400. During the war, tantalum for surgical purposes was in great demand in the form of sheet, foil, and wire, with probably its most successful surgical application in cranioplasty. Of all the metallic implants, it has the highest resistance to corrosion in vitro and in vivo. Furthermore, body reactions to it are strictly minimal.

Discussion with metallurgists revealed that the healing properties of the tantalum metal must be due to the oxide coating of the tantalum which is always present. Therefore, tantalum oxide powder was prepared in such a way that it was free of all fluorides and alkaline substances. As a dusting powder it is extremely soothing to areas of the skin which have been chafed or irritated. It is easily sterilized by heating at a temperature of 310 degrees F. in a dry oven and repeated sterilizations do not affect it. It is a material which can be kept easily at hand, and used in a perforated top glass bottle, a powder blower, or sometimes by dumping it out of an open container and spreading with a sterile applicator.

Indications for use of tantalum oxide include avulsed finger nails, chemical burns, diaper rashes, weeping lesions; it can also be used for surgeon's gloves, for intravaginal application, and as a packing for sockets of freshly extracted teeth.

The danger of secondary contamination due to redressing is practically eliminated by its use. Relief of pain is attributed to the tight sealing off which the tantalum oxide crust produces.

STEPHEN A. ZIEMAN, M.D.

Buggs, C. W., Bronstein, B., Hirshfield, J. W., and Pilling, M. A.: In Vitro Action of Streptomycin on Bacteria. *J. Am. M. Ass.*, 1946, 130: 64.

Streptomycin has been shown to be effective against a variety of gram positive and gram negative bacteria both in vivo and in vitro. Before it can be used rationally in treating disease, an evaluation of dose intervals and sizes, and determination of the bacterial susceptibility must be carried out. There are definite in vitro differences in bacterial sensitivity to streptomycin and within a given species strains may vary from extreme susceptibility to high resistance. The blood concentration of streptomycin reaches a peak soon after parenteral injection and then falls gradually to zero. To use the drug rationally, one must determine if a high enough concentration is being maintained with reference to the sensitivity of the particular strain of bacteria isolated. Frequently a smaller dose or longer interval between doses may be sufficient to maintain a blood level more than ample to inhibit the in vitro growth of the invading organism. On the other hand, these studies may indicate the need for larger doses given at more frequent intervals.

This study had a threefold purpose: (1) to determine the sensitivities of several species of bacteria to streptomycin; (2) to correlate these sensitivities with the serum concentration of streptomycin that may be maintained in patients; and (3) to determine whether the bacteria investigated developed a resistance to streptomycin in vivo.

Bacteria were isolated from 38 patients with various infections such as peritonitis, empyema, septicemia, infected wounds and burns, urinary tract infections, and pelvic abscesses. The urine or pus was cultured before and at intervals during treatment with streptomycin. Each organism present was isolated in pure culture, but complete identification of all the bacteria was not made. The following organisms were identified: escherichia coli, aerobacter aerogens, pseudomonas aeruginosa, alpha and beta hemolytic streptococci, and the staphylococcus. After the organisms were obtained in pure culture they were screened for their sensitivity to streptomycin, following which their sensitivity over a narrower range was determined. The action of streptomycin on anaerobic organisms was not determined.

The authors describe their method of screening to determine the approximate sensitivity to streptomycin, and a method to determine sensitivity values within narrower ranges than those possible with the twofold serial dilution method.

It has been found that the parenteral administration of 500,000 S units of streptomycin will maintain a serum concentration of from 10 to 15 units until the end of 4 hours. Theoretically, then, all bacteria reported in this article with a sensitivity of 8 units or less would be inhibited over a period of at least 4 hours by a parenteral injection of 500,000 S units of streptomycin.

Two hundred and twelve strains of bacteria were tested for susceptibility to streptomycin. The majority of the strains of escherichia coli, proteus vulgaris, aerobacter aerogenes, staphylococcus, and streptococcus were susceptible in vitro to the blood concentration of streptomycin that can be maintained in the average patient over a 4 hour period when he has been given 500,000 S unit dosages of

from 5 to 8 S units per cubic centimeter of blood. The majority of strains of pseudomonas aeruginosa investigated were found to be very resistant to streptomycin. Resistant strains of a given bacterium were isolated from patients subsequent to the isolation of sensitive strains. The assumption is that resistant strains developed from the sensitive strains. Diphtheroids were found to be either very sensitive or highly resistant to streptomycin.

ROBERT R. BIGELOW, M.D.

ANESTHESIA

Wilson, C. H.: Military Aspects of Early Analgesia and Anesthesia. *Current Res. Anesth.*, 1946, 25: 10.

The instructional approach to the military aspects of early analgesia and anesthesia at the Medical Field Service School had to be basic enough to include all of the important phases of the subject, and at the same time show the well trained anesthetist the problems he would encounter in forward anesthesia. This article discusses the overall problems involving analgesia and anesthesia in the combat areas.

The basic factor which determined the analgesic or anesthetic agents used was their availability. The drugs available to relieve pain were eugenol, acetylsalicylic acid, codeine sulfate, morphine sulfate, and morphine tartrate. The two narcotics available were phenobarbital and sodium amytal. The morphine syrette proved invaluable in the combat zone. One-half grain of morphine tartrate was dissolved in 1½ c.c. of fluid, placed in a tube with a rubber diaphragm and needle, and kept sterile with a celluloid shield. This simple morphine tube simplified injections in the combat area.

Morphine was contraindicated in head injuries, lung irritation from war gases, heat cramps, conditions resulting in anoxia and respiration depression, and conditions in which the symptoms had to be observed to determine the necessity of operative intervention. Stress was laid upon the use of morphine to relieve pain.

The anesthesia used forward of the evacuation hospitals had to be simple, safe, portable, and rapid in action control. Procaine hydrochloride was the agent of choice for nerve block. Inhalation agents were limited to ether, and chloroform was used as a reserve agent. The instructions concerning the use of intravenous anesthesia had two purposes. First, to keep medical officers informed and up-to-date concerning the official opinion of the Army Medical Department on the use of pentothal sodium. Second, to give basic facts about pentothal sodium to those physicians who had little, if any, knowledge of the drug. Care must be taken not to inject pentothal into an artery. The dangers of this drug were enumerated. It was considered hazardous in cases of morphine overdosage, shock, infection of the neck, cervical or sublingual infections, in operations with great blood loss, or those involving the airways. The methods of resuscitation were enumerated. The use of analeptic drugs was discouraged.

Spinal anesthesia had little value in the advanced medical units during active campaigning but was used in the clearing stations. Whenever available, inhalation anesthesia with positive pressure apparatus was preferred for serious chest injuries. General inhalation anesthesia was slow to give adequate relaxation for intra-abdominal surgery, and pentothal sodium was used more frequently than any other anesthetic agent by both the British and Americans in the many forward installations.

MARY KARP, M.D

Beecher, H. K.: Pain in Men Wounded in Battle. *Ann. Surg.*, 1946, 123: 96.

Two hundred and twenty-five freshly wounded men in the combat zone were studied for this report.

Attempts were made to correlate the pain with the extensiveness of the wound, and to question the routine employment of morphine in these wounded patients. Consecutive cases were observed with no selection other than that they had one of five kinds of wounds chosen as representative: extensive peripheral, soft tissue injury; compound fracture of a long bone; a penetrated head; a penetrated chest; and a penetrated abdomen. The patients chosen were clear mentally and were not in shock at the time of questioning.

The findings were as follows: 32.1 per cent had no pain, 25.6 per cent had slight pain, 18.6 per cent had moderate pain, and 23.7 per cent had severe pain.

Patients with penetrated abdomens had by far the most pain, possibly because of the spilling of blood and intestinal contents into the peritoneal cavity. Of all the patients considered, only one-fourth, on direct questioning, stated that their pain was severe enough to require pain relief therapy.

Data were presented to show that morphine was often administered by rote and not according to the patient's needs. When morphine was necessary the intravenous method was considered optimal to avoid the possibility of long delayed action during periods of peripheral circulation shock. Morphine should not be used in nervous or maniacal or hysterical states, to allay fear, or to promote sleep; for these purposes small doses of barbiturates have been adequate. Morphine should not be given in shock, unless pain is present, in hypothyroidism, in the presence of dysfunction of the liver, or when even a minor degree of anoxia exists.

Delayed morphine poisoning has occurred in battle casualties when the peripheral circulation was sluggish or inactive, as it might be in patients who are chilled and have low blood pressure.

The treatment of morphine poisoning includes the placing of a tourniquet, intermittently loosened, proximal to the site of the injection; the prevention of anoxia by oxygen administration and artificial respiration; and the intravenous administration of atropine, (gr. 1/160) or ephedrine (gr. ½) as a central stimulant. Hypertonic glucose may be

given intravenously to aid diuresis. Gastric lavage may be necessary. Body heat should be conserved.

Regional nerve block, proper splinting, and bandaging are of use in allaying pain. Wounded men need sedatives of the barbiturate type as well as narcotics at times, and small doses of both types of agents will accomplish what large doses of either alone will fail to do.

The man in shock complains far less frequently of the wound pain than he does of the great distress caused by thirst. MARY KARP, M.D.

Donatelli, L.: Mephedine as a Pharmacologic Product for Preparing the Patient for Anesthesia (La mefedina come farmaco de preparazione alla anestesia). *Policlin.* (*sez. chir.*) 1945, 52: 165.

Mephedine, a new synthetic alkaloid derived from piperidine (ethyl-ester of the hydrochloride of 1-carbonic acid, 4-methyl, 4-phenyl-piperidine), was subjected to a series of studies by the author at the Institute of Pharmacology and Toxicology of the University of Florence under the directorship of Mancini. These studies were calculated to determine its qualifications as a so-called preanesthetic preparation, that is, a preparation to render the induction of general anesthesia easier and less harmful to the patient. These studies might be divided into four groups or propositions: in the first, the action of mephedine on somatic and psychic sensitivity was investigated: in the second, any synergistic effects between mephedine and general and local anesthetic agents were considered: in the third, attempts were made to clarify any influence of mephedine on the more important and more common nervous reflex systems capable of suffering operative or anesthetic insult with reflex injury to the more vital vegetative functions: and, finally, in the fourth, attention was directed to any injurious secondary actions provoked by mephedine.

Group 1. The technique for this study in determining depression of the somatic sensitivity was that of Haffner (*Dtsch. med. Wschr.*, 1929, p. 731) using guinea pigs, and the degree of the drug effect was graded according to the animals' response to painful stimuli (pinching of the ear lobe).

The subcutaneous injections of 1 per cent mephedine (a dosage of 15 mgm. per kilogram) were found to have little effect on the pain response, whereas with dosages of from 20 to 50 mgm. the analgesic action became progressively more intense, with complete analgesia at the highest dosage. The effect became maximum within 10 minutes and lasted for from 60 to 120 minutes. Since Mancini has determined the minimal lethal dose for guinea pigs to be 180 mgm. per kilogram, the great margin of safety of mephedine deserves notice.

For measuring psychic depression (preoperative anxiety insult) of this drug, mice (mus musculus) were used after being accustomed to finding their way to food through a specially constructed labyrinth. After several days of accustoming the animals they would be given subcutaneous injections of from 25 to 50 mgm. per kilogram of mephedine and the subsequent time for traversing the labyrinth was observed. Again it was found that 25 minutes after 25 mgm. had been injected, and more pronouncedly when 50 mgm. were used, the animal had lost completely his ability to traverse the labyrinth: this effect disappeared more or less completely after 85 minutes. Some of the animals, especially those given 50 mgm., became permanently lost in the labyrinth.

Group 2. For the study of the potentiating effects of mephedine a general anesthetic preparation was selected and also a peripheral or local agent. The general anesthetic was the sodium salt of 5 (alpha methyl—beta cicloethenyl) 1 N methyl barbituric acid (evipal), and the local anesthetic was scurocaine (procaine hydrochloric acid). A third (general) anesthetic prepared was ether, 80 parts in 20 parts of olive oil for subcutaneous injection. The experimental animal employed was the rat (mus rattus). This animal was considered completely narcotized when it had fallen on its side, its head had fallen loosely, the body was immobile, and there was no reaction to painful stimuli.

In this experiment the animals were divided into groups, a control group receiving subcutaneously from 1 up to 10 c.c. of the ether (in 1 c.c. increases) in oil, the test group receiving 30 mgm. per kilogram of mephedine, which by itself always left the animal normal or perhaps even a trifle excited—this was followed 30 minutes later by the amounts of ether in oil specified for the control group. It was found that the rats treated previously by mephedine fell under narcosis much sooner than the corresponding controls, and slept much longer and more deeply. For instance, with the dosage of 7 c.c. per kilogram of the ether in oil the control slept for 3 minutes while the animal receiving the preliminary treatment with mephedine slept deeply for 87 minutes. From 2 to 6 c.c. of ether in oil were not sufficient to bring the animal under narcosis, but produced definite narcosis in pretreated subjects. The potentiating effect of mephedine on the anesthetizing power of ether in oil is so great as to reduce to one-half, or even to one-third, the amount of ether necessary.

In the corresponding studies on mephedine and evipal, the conditions were generally the same, except that guinea pigs (cavia cobaya) were the experimental animals used. Evipal in a 1 per cent solution was injected intraperitoneally in every animal; mephedine, in a 1 per cent solution, was injected subcutaneously, from 25 to 50 mgm. being used per kilogram of body weight of the guinea pig and the criteria of narcosis remaining the same for this animal as for the rat in the previous study.

With the larger of the 2 dosages of mephedine cited (50 mgm. per kilogram), torpor and analgesia would be produced, but never narcosis, while with the smaller dosage (25 mgm. per kilogram) the effect was rather an excitation of the animal. Likewise with the evipal, when administered alone, 25 mgm. were required to induce a narcosis of 34 minutes, while 50 mgm. lengthened the narcotic period to 70

minutes. With the mephedine preparation, however, the narcosis appeared sooner, lasted much longer, and was much deeper with more complete muscular relaxation. In fact, if 50 mgm. per kilogram of mephedine were administered to the subject previously, the 25 mgm. of evipal, which produced narcosis lasting for an average of 34 minutes, resulted in narcosis lasting 73 minutes, or more than twice as long; and with the aid of mephedine 15 mgm. of evipal became sufficient to induce the narcotic state.

In the succeeding studies with evipal used intravenously on rabbits the same potentiation on the part of mephedine was observable.

In order to test any potentiative effect of mephedine on the local anesthetic power of procaine hydrochloric acid, the corneal reflex of the guinea pig was used. This was induced by touching the cornea at second intervals with the Frey brush, from 2 to 10 such stimuli usually being sufficient. Procaine solutions in dilutions of 0.5 to 10 per thousand were instilled into the conjunctival sac and retained in contact for 2 or 3 minutes, the anesthetic action beginning at strengths of 0.8 per thousand. Mephedine given subcutaneously in doses of from 20 to 30 mgm. per kilogram and synchronously with the instillations of procaine induced corneal anesthesia, frequently intense, even with the smaller dose of mephedine (20 mgm. per kilogram), which of itself does not induce any evidence of such loss of sensitivity, and with the noneffective strength of procaine (0.7 per thousand solution). Similar effects were observed in subsequent experiments with rabbits as experimental animals, and there is little doubt left as to the potentiating power of mephedine on procaine hydrochloric acid with regard to its local anesthetic properties.

Group 3. To investigate the danger of damage or even death to the patient from reflex effects on the heart, respiration, or vomiting reflex, the rabbit was chosen for the experimental animal. It was tracheotomized and chloroform vapor was insufflated backward from the cephalad stump of the trachea through the pharyngeal and nasal passages, and the resulting responsive effects on the heart action and respiration were recorded by kymographic tracings. The same technique and tracings were produced after the endovenous perfusion of 1 mgm. per kilogram of a solution of mephedine in such a manner that the animals received 33 mgm. per kilogram of this drug when the reflex characteristics of these tracings, before the injection of mephedine, had entirely disappeared. Therefore, taking the reflex irritation of chloroform vapors on the nasopharyngeal area as typical of all induction irritation reflexes of the other anesthetics, and such reflexes as typical of all the reflexes incident to general anesthesia which are dangerous to the life of the anesthetized, it seems evident that mephedine, administered in advance of the inhalation anesthesia, is capable of depressing, or even annulling all of the dangers arising from irritation of the upper respiratory tract.

Mephedine likewise seems to obviate the dangerous respiratory and cardiac reflexes due to rough handling or pulling on a nerve during the operation. For this study the exposed sciatic nerve of the rabbit was stimulated electrically, it being found that all evidence of such reflexes began to decrease with the perfusion intravenously (within a space of 7 minutes) of 7 mgm. per kilogram of mephedine, and that all trace of such reflexes disappeared with higher dosages.

Likewise, in the case of the vagus reflexes, mephedine showed itself capable of suppressing the arrest of respiration and of the sudden hypertension and cardiac disturbances incident to stimulation of the central stump of the severed vagus nerve.

Identical results were induced in the nerve of Cyon of the rabbit, stimulation of which normally leads to such a sudden and severe bradycardia and fall of blood pressure; the necessary dose of mephedine in this instance was 14 mgm. per kilogram.

Although mephedine does not entirely abolish the carotid sinus reflex, it does attenuate such reflex and thus promises to obviate such incidents as arise during operations on the neck and floor of the mouth. These incidents are not always suppressed either by such anesthetic agents as evipal or by deep general inhalation anesthesia.

The author also investigated the reflexes due to pulling or other mishandling of pedicles and other forms of attachments of the organs. As a typical reflex he chose for study that produced by traction on the mesogastrium and suspensory ligaments of the stomach. This was accomplished by laparotomizing the animal (rabbit), and attaching a forceps to the stomach, then closing the abdomen, so that the stomach could be subjected to traction from the outside. Again the tracings showed that the consequent respiratory and cardiovascular reflexes could be abolished by the perfusion of 60 mgm. per kilogram of mephedine into the marginal vein of the rabbit within an hour's time.

Before concluding this section of his studies, the author reports some studies on mice. They had nothing to do with the suppression of reflex responses by mephedine, but were practically related to them. They concerned the primary, or induction excitation of the animal as produced by other types of anesthetic agents, of which he chose evipal as being typical. Six mice were injected endoperitoneally with 1 per cent solution of evipal, up to dosages of 20, 40, 60, 80, 100, and 120 mgm. per kilogram. Of these dosages, all except that of 20 mgm. produced violent excitation in the injected animal: there were also clonic convulsive attacks, followed by depression and ataxia. Forty milligrams produced convulsions and ataxia, but not narcosis, and the animals recovered after about 20 minutes; 60 mgm. or more caused narcosis and death in from 45 to 100 minutes; 20 mgm. had no effect whatever. Six other mice, 30 minutes previously, had received subcutaneous injections of 50 mgm. per kilogram (1 per cent solution) of mephedine; in these, 20 mgm. per kilogram of evipal induced narcosis without excitation within 10 minutes, which lasted several minutes; 40 mgm. or more produced death in narcosis without excitation.

Group 4. Mephedine in therapeutic doses exerts scarcely any or no action on the respiratory and cardiovascular systems, but in large amounts it constantly brings about a lowering of the blood pressure, and a reduction of the amplitude of cardiac contractions and of the respiratory frequency. These effects are, however, found with endovenous administration, but not with subcutaneous injection nor with very slow endovenous perfusion, even in large doses. For instance, with an endovenous perfusion of 60 mgm. of mephedine per kilogram in a rabbit, accomplished within a space of 60 minutes, the accompanying tracing did not show any substantial modification of the respiration: however, 10 minutes after perfusion of a rabbit with 60 mgm. of mephedine per kilogram and per hour, the tracing (revealing also the cardiac function) showed a lowering of the arterial blood pressure of about 30 mm. of Hg, and a diminution of the amplitude and frequency of respiration, without any evidence of disturbance of the heart action. This, however, tended soon to return to normal, so that at the end of 60 minutes (during which period 60 mgm. per kilogram has been administered) all of the functions appeared to be perfectly normal.

In conclusion, the author desires to call attention to the fact that mephedine exerts a spasmolytic action on all smooth muscle (vascular, bronchial, and intestinal), which effect deserves the attention of the surgeon. JOHN W. BRENNAN, M.D.

Allen, F. M., Crossman, L. W., and Lyons, L. V.: Intravenous Procaine Analgesia. *Current Res. Anesth.*, 1946, 25: 1.

The purpose of this work was to use intravenous procaine in the widest possible variety of painful conditions, the fundamental basis being that the great majority of pains are associated with local inflammation or edema. Thus, procaine diffusing through specially permeable capillaries may produce analgesia of the nerves in those tissues without important effects elsewhere in the body.

At first the original method as suggested by Lundy was adopted, with a 0.1 per cent procaine solution in physiological saline solution. The results of Lundy, Gordon, and McLachlin, and Bigelow and Harrison were confirmed. Subjective disturbances of overdoses were dizziness, blurred speech, or mental confusion. The literature suggested epinephrine as the antidote for respiratory symptoms of intoxication, and intravenous barbiturate for intoxication in the form of convulsions, but the authors saw few of these complications. In the group of obstetric cases in which procaine was infused intravenously, this method created an optimistic impression that it might prove to be the ideal obstetric anesthesia and the fulfillment of the quest for the prevention of pain during childbirth. A barbiturate was always administered as preliminary medication. Case reports were given in detail illustrating the use of intravenous procaine in such conditions as nucleus pulposus, gangrene, bed sore, and angina.

The authors modified the Lundy technique by increasing the quantities of infused fluid and procaine, by lengthening the period of infusion, by using glucose solution when saline solution might conduce to harmful edema, and by extending the range of application of the tests to all kinds of painful conditions. The method was found to have definite though limited value, and when hypersensitiveness to procaine had been excluded by preliminary tests and when the administration was kept within the limits set by dizziness or other subjective symptoms, there appeared to be no danger whatsoever.

The experience with obstetric operations was extended to ordinary surgical operations, of which 2 case records were summarized as examples of the method. In a hip pinning, 275 c.c. of salt solution containing 2.75 gm. of procaine were used during the course of 1¼ hours, and 4.25 gm. of procaine were used for a cholecystectomy in the course of 1¾ hours. The first patient remained practically unconscious throughout with wide open staring eyes and a wild expression, but later, on questioning, he claimed that he could remember what was said and done during the operation, but that he had no pain at any time. The second patient had the appearance of normal sleep, with a peaceful facial expression and imperfect muscular relaxation. The method has the advantage of rapid and flexible control, absence of accompanying injury or after effects, and a high degree of safety, as far as can be judged to date. As soon as possible, collaborative studies will be published, which will attempt to establish a more adequate basis for acceptance or rejection of the method.

The infusion in higher dosage has produced a clinically new form of general anesthesia by action upon the central nervous system. It is hoped that this method will prove valuable for various purposes, but there has not yet been sufficient experience to define accurately the uses, limitations, or possible dangers. MARY KARP, M.D.

Lobachev, S. V.: Refrigeration Anesthesia in Surgery of the Extremities. *Current Res. Anesth.*, 1946, 25: 22.

Investigational work was done at the Sklifossovski Institute of Moscow on the technique of refrigeration anesthesia, the history and bacterial flora of cooled tissues, and the relation of this anesthesia to shock. The material consisted of 100 cases, 87 of which were traumatic injuries, 4 of gangrene due to vascular diseases, and 9 of septicemia. Refrigeration anesthesia was considered excellent in 75 per cent of the cases, good (slight pain on handling the nerve trunks) in 22 per cent, and poor (addition of ether required) in 3 per cent. Postoperative complications occurred in 12 cases; 4 developed wound infections. The mortality rate was 3 per cent, 2 patients succumbing within 24 hours to a high stage traumatic amputation of both thighs complicated by brain injury, and a third pa-

tient dying from milary tuberculosis of the lungs 2 months after the operation.

The tourniquet site selected was encased in ice for from 15 to 30 minutes, and then the tourniquet was applied. Soft elastic rubber was used for this purpose, the width of the rubber making no difference. The extremity was lifted prior to the application of the tourniquet in order to drain away the blood. The limb was then placed on a leather sheet filled with ice or snow and this was covered with another thick layer of ice or snow extending to from 5 to 10 cm. above the tourniquet. It was found that the temperature of the deep structures at the site of the incision was between plus 5 and plus 10 degrees C. when the anesthesia was sufficient for surgical intervention. More intensive cooling caused irreparable damage to the tissues, while higher temperature resulted in unsatisfactory anesthesia. Without a tourniquet the cooling was unequally distributed. The cooling time needed was from 90 to 120 minutes for the thigh, from 60 to 90 minutes for the leg, and from 45 to 60 minutes for the arm and the forearm.

The temperature of the stump gradually returned to normal an hour after the tourniquet was released. After the stump was dressed it was covered with ice packs for 48 hours, and the sutures were removed 12 or 13 days postoperatively as the healing was somewhat retarded because of the reduced metabolism of the cooled tissues.

It was found that pain sensibility of the limb was the first to disappear on cooling, followed by loss of temperature sensation, and finally by loss of tactile senses. Histologically, the tissues examined during refrigeration did not differ from those of normal controlled tissues.

Primary suppuration was rarely found in spite of the injuries contracted in the streets. The bacteriological studies showed that the growth of microorganisms was inhibited. The pulse was not altered even in serious cases, but respirations were accelerated. The temperature remained normal in that part of the body not refrigerated. There was no increase of palor, sweat, or cyanosis during the operation. The patient usually responded to stimuli more actively as soon as refrigeration was effected. Apathy and somnolence gradually disappeared.

The advantages were summarized as follows:

1. No anesthetic drugs are introduced into the system.

2. There is a local reduction of temperature which counteracts the traumatic shock by numbing the tissues and especially the nerves.

3. The application of the tourniquet and the cooling of the limb retards the formation and absorption of toxins.

4. Toxemia is reduced and shock is controlled.

5. This method has special advantages in the aged and in patients who are seriously ill with septicemia.

MARY KARP, M.D.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Morales, O.: A Case of Roentgenologically Observed Perirenal Edema after Therapy with Sulfanilamide Preparations. *Acta radiol.*, Stockh., 1945, 26: 334.

The urinary complications in connection with sulfanilamide therapy consist of edema, necrosis, hemorrhage, and venous thrombosis; they may occur in the renal parenchyma, the pelves, and the ureters. They are produced partly by toxic, and partly by mechanical action of the precipitated sulfapyridine crystals.

The author recently has observed a new type of complication which he describes as perirenal edema. This occurred in a woman, 37 years of age, who received massive sulfanilamide therapy for suspected bronchopneumonia. In a period of 4 days, 24 gm. were given altogether. Already during the course of treatment the patient developed severe pain in the left kidney region, followed by crystalluria, hematuria, and oliguria.

Roentgen study, made a day after the medication was discontinued, revealed nonvisualization of the left renal and psoas muscle shadows, without elevation of the diaphragmatic dome, pleural exudate, atelectasis of the left lower lung, and lumbar scoliosis, as observed in perinephritis. Intravenous pyelography showed a normal urogram on the right side, but no excretion of the contrast medium or any increased density of the kidney on the left side. Three days later, cystoscopic examination demonstrated marked edema of the mouth of the left ureter, with total suppression of the urine on this side. There was a polynuclear leucocytosis. Subsequent check-up cystoscopic and roentgenographic examinations elicited the fact that after about a month both the function and the appearance of the left kidney returned to normal. The last intravenous pyelography showed satisfactory urograms on both sides with good visualization of the kidney and psoas muscle shadows.

It is the author's contention that since the accessory signs of perinephritis, as described above, were missing, the condition represented perirenal edema and not a common bacterial inflammatory lesion.

T. Leucutia, M.D.

Moller, P. F.: The Roentgen Picture of the Tabetic Arthropathies and Affections of Bones. *Acta radiol.*, Stockh., 1945, 26: 535.

Because of the increased incidence of fresh syphilis during the war years one might expect to encounter again, in Denmark, tabetic bone and joint lesions in the years to come. This justifies a discussion of this subject with the assistance of old films obtained from the archives of the State Hospital in Copenhagen.

Fig. 1. The calluslike new formations about tabetic fractures and changes in the joints are resorbed to a great extent with rest and surgical treatment.

The basic pathology of the lesions is obscure. The only certain fact is the increased brittleness of the bones and cartilages. Dilatation of the haversian canals to confluent cavities filled with fat cells, and a decrease of the phosphate content of the bones have been reported by some investigators. All authors agree that the lesions are caused by a disturbance of the innervation of the affected bones and joints. The lesions can, therefore, be found also in syringomyelia, myelitis, postencephalitis, paraplegia, disease of the posterior nerve roots, and other affections of the central nervous system. In tabes the lower extremities and the spine are more frequently involved; in syringomyelia the upper limbs. Although the first description of these lesions is commonly attributed to Charcot (1868), Mitchell had mentioned them already in 1831. The first roentgenograph of a so-called "Charcot's joint" was published by Wilms in 1899.

The roentgen manifestations can be divided into two groups:

1. Fractures, spontaneous or after slight trauma. Since these are painless they may remain undetected for long periods of time. When they are finally seen they are usually associated with abundant callus, severe myositis ossificans (which may simulate bone sarcoma), an unusual degree of fragmentation, and aseptic necrosis, which in some cases of femoral neck fracture may cause the head of the femur to disappear completely.

2. Joint lesions. These display considerable destruction of the joint forming bone ends with eburnation, enormous osteophytes, and other new bone formation which may completely surround the joint,

which then appears to be embedded in a spongy mass. Myositis ossificans may add further layers of calcium around the joint. Numerous loose bodies are frequently present, often arranged in clusters to give the so-called "bag of nuts" appearance. Although considerable swelling is usually present, fever and other signs of inflammation are absent. The lesion may, therefore, progress unattended until multiple fractures in the adjacent bones and a dislocation cause complete mechanical disability.

A complicating pyarthrosis may make the differential diagnosis difficult. Ordinary degenerative arthritis may be distinguished from neurogenic joint lesions by the absence of subchondral cyst formation in the latter. The rapid progression, the severity of the lesions, and, if present, a perforating ulcer of the foot supplement the diagnosis of tabetic arthropathy.

A spontaneous fracture or a fracture after slight trauma may be the first sign of tabes.

GERHART S. SCHWARZ, M.D.

Bauer, G.: Observations on the Technique of Phlebography. *Acta radiol.*, Stockh., 1945, 26: 577.

The author, who has conducted 500 phlebographies since 1938, reports his findings in 180 leg phlebograms of patients suspected of developing thrombosis of the leg veins. The purpose of these examinations was to make possible the early therapeutic administration of heparin or dicumarol, which indeed succeeded in preventing the spread of thrombophlebitis to the thigh in all treated cases. The findings were as follows:

Fig. 1. No visualization of the deep venous trunks in the middle third of the lower leg, due to thrombosis. Within 2 days phlegmasia alba dolens occurred.

In 73 cases the failure of the deep veins to visualize was considered evidence of thrombosis. In 62 cases there was good or fair visualization of all the main veins. None of these patients developed signs or symptoms of thrombosis subsequently. Eighteen cases displayed sectional occlusion of a vein with dilatation of the preceding vessel segment. In 27 cases single or multiple filling defects were found. In 42 of the 45 cases comprising the latter two groups, good circumstantial or indirect evidence of thrombosis could be established.

From his findings the author draws the following conclusions:

1. The most reliable x-ray sign of thrombosis is nonvisualization of the deep veins. An apparent constriction of a visualized vein to a threadlike caliber represents sedimentation of the contrast material and is not significant. It occurs only if the leg is placed in the horizontal position, a position which, nevertheless, is to be preferred to the vertical for various other reasons.

2. Another valuable sign is filling defects caused by nonocclusive space occupying thrombi in the veins. These might be confused with false filling defects which are located at ramification points of the vessels. They are caused by displacement of the contrast material by reflux of the fresh blood from a side vein into the visualized vessel and are smaller than the former.

Various techniques are discussed. The author recommends perabrodil or diodrast (35 or 50%) for contrast material. An acceptable substitute is a mixture of equal parts of intron and physiological saline solution. It necessitates, however, the flushing of the veins with from 10 to 20 c.c. of saline solution in patients who experience cramplike pains in the calf after the injection. Section of the lateral malleolar vein is preferred to percutaneous venipuncture. Two stereoscopic films are better than a single film but not as good as a single frontal and a single lateral film of the leg combined.

GERHART S. SCHWARZ, M.D.

Lodge, T.: The Anatomy of the Blood Vessels of the Human Lung as Applied to Chest Radiology. *Brit. J. Radiol.*, 1946, 19: 1.

The literature on the gross anatomy of human pulmonary arteries, veins, and bronchi is summarized with special stress on the topographical relationships of these structures and the part played by radiological methods in establishing them. The author then recounts his own findings in pulmonary bronchovascular relationships in the normal, which he plans to use later as a base for radiographic study of pulmonary vascular changes in response to disease or physiological stresses.

In this present study of the normal, three methods were used: the production of celloidin models by the modified corrosion technique (Fig. 1), radiography of the lungs following injection of the vessels with

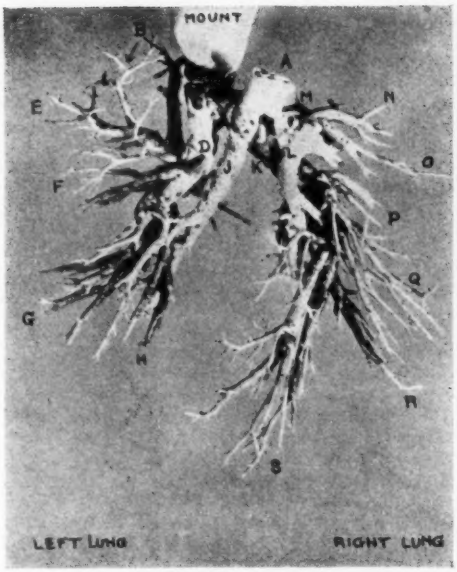


Fig. 1. Celloidin model of the bronchi and arteries of the two lungs as seen from the posterior aspect. The trachea and bronchi are lighter colored and the arterial system is dark. Key to figure: A, trachea; B, apical artery; C, pulmonary artery; D, left pulmonary artery; E, axillary artery; F, pectoral artery; G, axillary basal artery; H, posterior basal artery; I, lingular artery; J, left main bronchus; K, right pulmonary artery; L, right main bronchus; M, pectoral artery; N, apical artery; O, axillary artery; P, first posterior-horizontal; Q, second posterior-horizontal; R, axillary basal artery; S, posterior basal artery.

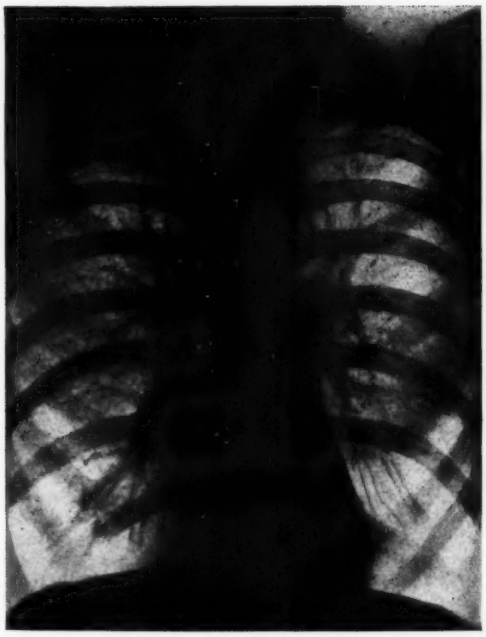


Fig. 2. Chest roentgenograph showing particularly clearly the distribution of the main arterial trunks in both lungs. The right lower lobe vein can be seen between the tenth and eleventh ribs, and in the left midzone the long tapering trunk passing downward is the lingular artery. The roentgenograph also illustrates thinning of the vessels at the left base, where there is clinical evidence of emphysema. These vessels should be compared with those of the right base, which are much thicker.

barium sulfate suspension and tomography in the living subject. The author then applied the knowledge so gained in ascertaining which anatomical vessels could ordinarily be seen, and with what frequency and variation, in the posteroanterior roentgenographs of 100 normal individuals.

He stresses the generally accepted facts that the linear shadows seen traversing the lung fields in normal roentgenographs are produced by blood-filled arteries and veins, and not by bronchi, and that the vascular distribution of the left lung is essentially homologous with that of the right, the lingular artery on the left substituting with considerable exactitude for the right middle lobe artery, with the exception that the former is derived from the left upper lobe artery and the latter from the right intermediate artery.

In general, the author's findings in vessel bronchus relationships in the human being were similar to those of Miller in the lungs of pigs and dogs, and followed Greineder's law: namely, that artery, bronchus, and vein are found in that order proceeding anticlockwise in the right lung, and in the same order but clockwise in the left. The whole pulmonary arterial system was seen to follow the branching and distribution of the bronchial tree to its termination, whereas the veins tended to lie distant from the bronchi in their interspaces and to cross the bronchi at an angle.

Some veins may be seen to cross the arteries at an angle of almost 90 degrees, an observation useful in differentiating veins from arteries in the roentgenograph.

On attempting to apply the knowledge gained by these studies to the survey of the roentgenographs of 100 normal subjects, the author found it possible to recognize and name the majority of the first and second order branches (Fig. 2). He calls attention to the fact that the shadows of the veins are, in general, less dense and less clear cut, but wider, than those of the corresponding arteries, and to the observation that vessel shadows are either straight or gently curved, but never tortuous or taut.

LILIAN DONALDSON, M.D.

Pfahler, G. E.: The Development of Roentgen Therapy during 50 Years. *Radiology*, 1945, 45: 503.

The author remarks on the almost immediate attempt on the part of physicians in all parts of the world to turn Roentgen's discovery of the x-rays in December, 1895, to therapeutic uses. The interest in fluoroscopic examinations with the new rays, in the absence of any protection or any warning sensations, early led to recognized damage of the skin of the hands and faces of the investigators, while in some patients the prolonged exposure time necessary for making skull plates resulted in alopecia. The discovery of this epilating effect led Freund to treat a disfiguring hairy nevus in a young girl. He reported his results in January, 1897, and widespread use of x-rays in the therapy of skin diseases followed.

At the time of the discovery of x-rays the essential equipment—Ruhmkorff or Tesla coils, or a static machine, and Crookes tubes—was already at hand in every well established laboratory of physics (Figs. 1 and 2), and hence the necessary parts were quickly available to physicians, but dosage for a given procedure was unknown and there were no instruments to record the physical factors used. The intensity of the current and the penetrating quality of the rays were estimated by holding the hand in front of the fluoroscope; dosage was estimated by biological effect—erythema or epilation. Ammeter, milliampere meter, and spintherometer were, however, developed relatively soon, and the intensity of irradiation and dosage began to be estimated by photographic effects or the darkening of barium platinocyanide discs. The small volume of cu rent produced in early apparatus necessitated tremendous exposure times, so that the tubes quickly became overheated and the rays softer. The development of the interrupterless coil by Snook in 1905, leading to great increase in volume of the current produced, the modifications of the Crookes (gas) tube, together with accessory radiator and water cooling devices, and, finally, the development of the hot cathode high vacuum tube by Coolidge in 1913 overcame many of these early difficulties. These advances made possible sufficient constancy in volume and quality of the rays to enable radiologists to duplicate diagnostic and therapeutic results in different patients. It was years, however, before the ionization effects produced by the x-rays, first reported by Roentgen in March, 1896, led to the development of practical instruments for their measurement, and the establishment of the unit of dose, the roentgen, in terms of that ionization (1928).

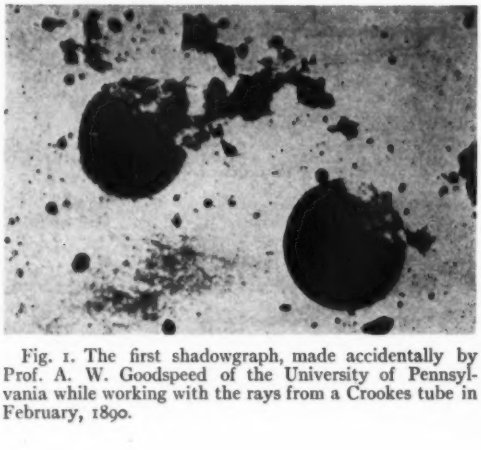
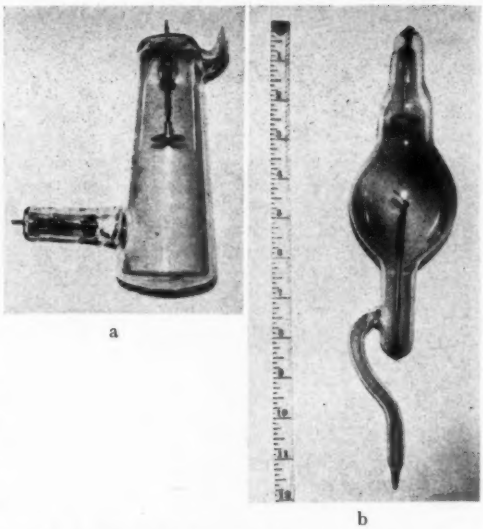


Fig. 1. The first shadowgraph, made accidentally by Prof. A. W. Goodspeed of the University of Pennsylvania while working with the rays from a Crookes tube in February, 1890.



a b

Fig. 2. a. Crookes tube, reproduced by H. C. Rentschler, Westinghouse Electric & Manufacturing Co. from designs furnished by Mutscheller, to represent the type of tube used by Roentgen in his discovery of the rays. Observe that the target was the bottom of the glass tube. b. One of the tubes used in the Medico-Chirurgical College laboratory by M. K. Kassabian. This tube, made in 1897, has a cup shaped cathode and an iridio-platinum target. The size of these tubes is indicated by the tape measure (in inches). It will be observed that the bulb of the tube shown in B is not more than 3 inches in diameter.

Early therapeutic radiation was unfiltered. Perthe's depth dose measurements in 1904, showing that the intensity of the x-rays diminishes rapidly from the surface to the depth of the body treated and that this decrease in intensity is much less if an absorbing layer such as 1 mm. of aluminum is placed on the surface, led to the use of filters in Europe. When higher voltage equipment became available with the production of a greater proportion of shorter rays, filtration was increased both as to thickness and density of the metal chosen.

As it became possible to produce x-rays of varying qualities, knowledge of the type of ray best suited to

the condition to be treated had to be sought, and the technique of application worked out. It became generally accepted, for example, that in the treatment of ringworm of the scalp the "epilation dose" should be given accurately at a single sitting even though a large area is covered, but in most inflammations and malignant neoplasms the full dose should be divided; that for acute inflammations the dosage should be very small and given at short intervals, and for chronic inflammations larger doses and longer intervals are indicated. Bergonie and Tribondeau had found in 1904 that immature cells and cells in an active stage of division were more sensitive than those which had already acquired the adult or resting stage, and 10 years later Regaud stressed the importance, in the treatment of malignancies, of fractional doses of comparatively low intensity extending over a long period, since more neoplastic cells would thereby be exposed to irradiation during phases of mitosis. Coutard used these principles when, about 1920, he modified the treatment of malignant tumors, especially of the oropharynx and larynx, to obtain a high total dose with increased destructive effect on the tumor cells, but with relatively less damage to the overlying normal tissue than had been possible with some of the previous methods. Recent development of supervoltage equipment has presented further problems in dosage.

LILIAN DONALDSON, M.D.

Poulsen, B. R.: Investigation into the Time Factor in the Roentgen Irradiation of Cancer Cells. *Acta radiol.*, Stockh., 1945, 26: 463.

A round cell sarcoma and a certain type of mouse carcinoma were irradiated by x-rays of varying intensities over varied periods of time and the resulting effects were compared.

The tumor tissue was transplanted to a homogenous strain of mice before irradiation. All of the mice then received irradiation of the whole body. After a period of not more than 24 hours after completion of the exposure (depending on the experiment group) the tumors were removed from the mice. The tumor tissues of all mice of the same experimental group were then mixed by mincing in order to minimize the individual variations. This tissue mixture was transplanted into a number of healthy mice, and the effect of irradiation was then assessed:

(A). By the "take percentage," i.e., the percentage of animals in which the tumor grew after transplantation and irradiation.

(B). By the mean latent period, i.e., the number of days after which 50 per cent of the takes became apparent as palpable tumors. (The normal values for nonirradiated tumor tissue are 5 days for sarcoma and 6 or 7 days for carcinoma.)

Four intensities of radiation were used: 58 r./min., 12.3 r./min., 3.3 r./min. and 1 r./min. The delivered dose was the same in all of the cases, i.e., 1,160 r. to the mice with sarcoma and 1,600 r. to the mice with carcinoma. A middle dose was delivered by a single exposure of the mice to continuous radiation of constant intensity which varied only with the experiment. This necessitated exposure times ranging from 20 to 1,600 minutes.

The principal findings were as follows:

1. Round cell sarcoma. The take percentage dropped 25 per cent and the mean latent period rose from 15 to 18 days when the intensity was lowered from 58 r./min. to 1 r./min. The main change was observed at the lowest intensity which is therefore considered a "critical intensity." This tumor is thus more sensitive to low intensity radiation. The most effective intensity has not been reached in the experiment but can be assumed to lie below the critical intensity of 1 r./min.

2. Kreb's No. 2 mouse carcinoma. A drop of the intensity causes a proportionate rise of the percentage takes (up to 20%), and a reduction of the mean latent period from 17 to 13 days. This indicates that protraction reduces the effectiveness of radiation on this type of tumor. No critical intensity was observed with this tumor.

A number of histological examinations of both tumors was performed after exposure to staggered doses of x-rays (in steps of 500 r.) in order to study the relation of the cell life cycle to radiosensitivity. Within the studied range only the sarcoma displayed a cyclic response to irradiation. Mitosis of the sarcoma cells was increased after a certain low dose of x-rays was delivered to the specimen.

The author arrives at the following conclusions:

Within the studied range the carcinoma becomes more radioresistant with increasing protraction probably because the cumulative effect of radiation is more than counteracted by the recovery which takes place during the low intensity irradiation.

The sarcoma becomes more sensitive to radiation with increasing protraction because of the increased probability that the cells are affected during the sensitive phase of their cycle. This cycle may be intrinsic (the sensitive phase being the stage of premitosis) or induced by the physicochemical action of the x-rays.

GERHART S. SCHWARZ, M.D.

MISCELLANEOUS

Timmes, J. J.: Radiation Sickness in Nagasaki; Preliminary Report. *U.S. Nav. M. Bull.*, 1946, 46: 219.

The author in this preliminary report presents his observations made in Nagasaki on the radiation effects resulting from the explosion of the atomic bomb. The study was begun 33 days after the initial blast. It was conducted at an improvised hospital established at the Chinkozen Primary School, a fact which explains the many difficulties encountered.

In the beginning an average of 20 new cases were admitted to the hospital daily, but within 2 weeks this number dropped to 1 or 2 new cases daily. The

investigation was abruptly terminated on September 25, 1945, but some follow-up reports were secured later and they were sent to S. L. Warren and Shields Warren, in charge of the Army and Navy scientific atomic bomb commissions, respectively.

The explosion of the atomic bomb is associated with a sudden excessive release of pressure, heat, and radiation. The effects of the pressure and heat on human beings differ in no way from those of the ordinary bomb, but the release of radiant energy is something new.

The first concern was the possible remaining radioactivity on the ground and in the victims. The bomb was exploded at an estimated altitude of 800 feet with the aim to expend as much as possible of the radiant energy into the atmosphere. The author buried x-ray films in the bombed area, attached others to various objects about the so-called crater (a true crater does not exist). They all remained negative. Later investigators, with the aid of the Geiger counter, likewise found the area safe, as this extremely sensitive instrument registers only negligible amounts of radiation. The effect on the victims was studied by attaching x-ray films to their limbs for 18 hours. These, too, remained negative.

Another point of interest was the radiation sickness. The Japanese claimed that most of the deaths occurring during the first week after the blast were the result of this illness. However, they did not differentiate between blast victims and radiation victims and attributed many of the thermal burns to radiation burns. It is the author's impression that a large percentage of the early victims, indeed, died of the radiation effect. This is explained by the fact that most of the civilians were not in air raid shelters when the bomb was dropped. Concrete walls of 2 feet thickness probably would have afforded adequate protection.

A study of the patients themselves revealed some interesting data. All victims observed had been within 3 kilometers of the center of explosion.

There were only a few x-ray skin burns and they were mild in character. However, many cases of alopecia were seen. In some, the hair started to fall out 4 to 5 days after the explosion, in others about the third week. At the end of a month a few of the patients had already begun to grow new hair of a downy nature. In none of the cases was the loss of hair complete.

The most important effect of the radiation was on the bone marrow, the majority of the cases exhibiting an aplastic type of anemia. A white blood cell count under 1,000 indicated a poor prognosis, although 1 patient with a 400 count recovered. In some instances the blood cells completely disappeared before death. Petechiae, gross hemorrhages, increased bleeding times (often above 45 minutes), thrombocytopenia, and urine revealing the presence of nephritis, were noted frequently.

The average newly admitted patient complained of fever, malaise, loss of appetite, bleeding gingivae, and hemorrhagic diarrhea. Oral changes constituted common occurrences. The tongue was of a smooth glossy appearance and the mucosal membranes showed changes varying from a simple inflammatory lesion to deep necrosis. The teeth were generally loose and easily removed by hand. Two cases of necrosis of the mandible and 1 of noma were seen. Terminal infection, particularly bronchopneumonia, was found to be the most frequent immediate cause of death.

The prognosis was difficult to evaluate. Youth and a progressive rise in the white blood cell count represented good signs.

Therapeutic opportunities were limited.

T. Leucutia, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Emerson, C. P., Jr., and Ebert, R. V.: A Study of Shock in Battle Casualties. *Ann. Surg.*, 1945, 122: 745.

One hundred and twelve battle casualties admitted to a field hospital with serious abdominal, chest, or extremity wounds have been studied by the authors. Fifty per cent of these patients were in severe shock. Detailed clinical observations were made in all cases, as well as serial determinations of either the hemoglobin concentration or hematocrit reading. Measurements of the plasma volume and plasma protein concentration, as well as hematocrit readings, were completed in 57 cases; in 33 cases multiple blood volume determinations were made, either in the course of transfusion therapy, or before and after operation.

The arterial blood pressure was found to provide the most reliable clinical index of blood volume deficiency. All patients with initial systolic pressures below 85 mm. of mercury, excluding those with spinal cord transection, were found to have marked oligemia, the deficit averaging 40 per cent of the expected normal blood volume; all patients with this degree of hypotension had a diminution in blood volume that exceeded 25 per cent.

Blood volume and plasma protein measurements indicated that some degree of spontaneous hemodilution with low protein fluid often occurred in patients suffering from oligemic shock; the amount of this dilution, however, was small, rarely exceeding 200 c.c. It is concluded that a normal hematocrit reading, or the demonstration of a mild anemia within a few hours after injury is no indication that a severe blood loss has not occurred. Severe anemia was produced by the administration of plasma to patients with marked oligemia.

The majority of patients presented no evidence of an excessive loss of plasma in proportion to the red cells; in a few with severe abdominal wounds there was demonstrated a disproportionate plasma loss, which resulted in a mild degree of erythroconcentration. The average total blood loss estimated to have occurred in cases of severe shock before admission to the hospital was 63 per cent. Hemorrhage appeared to have been most severe in patients with wounds of the extremities, and least severe in patients with uncomplicated chest wounds.

Blood volume measurements were performed preoperatively and postoperatively in 10 cases, in order to ascertain the degree of blood loss occurring in the course of various surgical procedures. The average loss in 3 patients subjected to open thoracotomy was 600 c.c.; 5 patients requiring extensive abdominal surgery lost an average of approximately 2,200 c.c. of blood.

Serial determinations of the blood volume indicated that hemorrhage occurred during the course of transfusion therapy in 11 of 23 patients studied. This complication was encountered most commonly in patients with severe wounds of the extremities, a majority of these patients suffering a loss which averaged 40 per cent of the blood and plasma transfused.

Plasma protein measurements before and after the injection of blood diluted with equal volumes of preservative solution indicate that retention of the latter in the blood stream is transient and not enough to produce significant hemodilution.

The mortality incidence of all patients admitted in severe shock was 32 per cent; of those whose arterial pressure on admission exceeded 85 mm. of mercury, 11 per cent died within a similar period, which included the first postoperative day. The majority of deaths were due to penetrating abdominal wounds.

Cases are described in which the clinical signs of shock were unrelieved by therapy, despite complete restoration of the blood volume to normal. The factors operative in the production of "irreversible shock" included severe infection, lesions involving the central nervous system, anoxic anoxia due to pulmonary damage, and long persisting combinations of anemia, oligemia, and hypotension, with terminal signs of myocardial insufficiency.

Therapeutic indications for the use of whole blood and plasma are cited, and criteria for evaluating the requisite amount of transfusion therapy are discussed. JOSEPH GASTER, M.D.

Brun, C., Knudsen, E. O. E., and Raaschou, F.: Postsyncopal Oliguria. Kidney Function and Circulatory Collapse. The Cause of Postsyncopal Oliguria. *Acta med. scand.*, 1945, 122:381, 486.

In the passive erect posture with a tilting board, unintentional circulatory collapse occurs frequently. This is immediately followed by reduced diuresis which the authors call postsyncopal oliguria. This article deals with the investigation of renal function during postsyncopal oliguria and the cause of the latter.

Sixteen tilting experiments were done, all of which were complicated by circulatory collapse. The oliguria lasted from 15 to about 90 minutes after the syncope, the duration apparently being proportional to the fall in blood pressure. The diuresis always dropped to values of from .3 to 1 ml./min. and the specific gravity of the urine rose to about 1.020 or 1.025. The inulin concentration index during oliguria rose to about 120 from the normal of about 12, and the inulin clearance (glomerular filtration) was reduced slightly or excessively. In the latter instance, when diuresis was resumed, there followed briefly an increase to unexpectedly high values. The urea clearance was reduced in the period

immediately after syncope and then followed by normal values. Fluctuations occurred as in the case of inulin and diodrast clearances, but they were not nearly so pronounced, presumably as a result of the increased return of urea in the tubuli during the oliguria.

Since plasma is cleansed completely, or nearly so, of diodrast by a single passage through the kidneys, diodrast clearance was taken as a measure of the quantity of the renal plasma flow. Diodrast is excreted mainly in the renal tubules, and only to a smaller extent by filtration in the glomeruli.

Diodrast clearance often was reduced slightly just after syncope and then returned to the initial value. However, if the drop was great, there followed a marked temporary rise before the fall to normal. The filtration fraction was without significant change during the period of oliguria. Hemoconcentration occurred during syncope, but after the individual had been put back to the horizontal posture, there was a gradual dilution of the blood to a temporary, lower than normal, level toward the termination of the study. The blood pressure and pulse rate remained unaffected.

In the discussion, emphasis is placed on the chance for error (lavage phenomenon) in the clearance determinations, which were then corrected and properly evaluated. Thus, the glomerular filtration and renal plasma flow are found to be normal during the period of oliguria.

These findings, together with the high concentration index for inulin and the high specific gravity for urine, point to a greatly increased reabsorption of water in the renal tubules rather than to a decreased glomerular filtration as the mechanism which governs oliguria.

The authors then postulate that postsyncopal oliguria is induced by a suddenly increased supply of antidiuretic hormone from the posterior lobe of the pituitary gland, reflexly stimulated by either the cerebral anoxia or by the effect on the pressoreceptors which is caused by the fall of the blood pressure.

Having postulated previously that an antidiuretic hormone from the posterior lobe of the pituitary gland was responsible for the greatly increased reabsorption of water in the renal tubuli, which produced a postsyncopal oliguria, the authors endeavored to demonstrate the occurrence of this hormone.

First they tried to show that the effect on the diuresis is of a humoral nature by transfusing blood from newly collapsed subjects. Three of the recipients, sustained a diuresis fall comparable in severity and duration to the amount of blood transfused. In 4 out of 5 control experiments, there was no change. The other recipient experienced a diuresis fall which was thought to be due to reflex action on the pituitary gland from repeated painful punctures during the venesection.

Since the posterior lobe hormone of the pituitary gland is supposed to regulate the excretion of chloride in the kidneys, the chloride output in the urine was determined after collapse and after oliguria transmitted by transfusion. The findings were identical with those observed after the ingestion of insipidin, an antidiuretic extract of the posterior pituitary lobe. The minute chloride output did not increase but the chloride concentration index fell below 1 while the plasma concentration decreased, and the chloride in the urine increased markedly.

Finally, studies were made on 2 patients suffering from diabetes insipidus. These patients are assumed to have a reduced production of antidiuretic hormone. The postsyncopal oliguria was as marked as in normal people but of much shorter duration. The urine chloride concentration rose to considerably below the plasma chloride concentration. The same conditions prevailed after an insipidin injection. The short period of oliguria would tend to point to an inability on the part of a patient with diabetes insipidus to produce antidiuretic pituitary hormone.

These three series of studies taken together suggest that postsyncopal oliguria is conditioned by the pituitary gland. The authors are quick to point out that this type of oliguria is probably merely an accompanying phenomenon to another pituitary regulation, first and foremost being a regulation of the tone of the capillaries. The oliguria often seen clinically in circulatory insufficiency, viz., in shock states from burns, anesthesia, and hemorrhage, is designated as collapse oliguria in contrast to postsyncopal oliguria, during which period the blood pressure is normal.

DAVID H. LYNN, M.D.

Imperati, L.: Malaria in the Practice of Surgery. The Inter-Relationships between Malarial Infections and Surgical Diseases (La malaria in chirurgia. Rapporti fra infezione malarica e malattie chirurgiche). *Gior. ital. chir.*, 1945, 1: 15.

The author was a captain in the medical branch of the Italian military forces in Sardinia, stationed at first at the principal military hospital at Cagliari and later transferred to Iglesias. During this time he witnessed the disquieting recrudescence of malaria in that country and gained the experience which he details in part in a series of articles of which the first is covered by this abstract. A second article will be concerned with the problem of surgery in the patient with malarial splenomegaly, and a third will treat of surgery in the malarial patient.

After a relatively brief discussion of his subject—including the pathogenicity of the plasmodium at different places and times, and in relation to the varying resistance of the patient; the effect of chronic malaria on the reticuloendothelial system; and the melanocculation flocculation of Henry—the author turns to the details of his own personal views and experiences. This discussion is again divided into subsections, the first concerning the malarial recurrences appearing as a result of surgical injuries, and the second concerning the surgical syndromes occurring as manifestations of malarial infection.

In deciding on the complicity of the malarial plasmodium in the febrile condition of the patient,

the author and his coworkers have depended as often on the leucopenia with the relative mononucleosis of malaria as on the actual finding of the parasite in the blood cells, and malaria has been suspected even in continuous fevers, since recurrent malaria is capable of producing a remittent continuous temperature.

The author remembers one instance of a thoracotomized pleural empyema, in which after an initial favorable course a fever of a remittent continuous type suddenly developed; intense and prolonged treatment with quinine produced a fall in the temperature, although no blood parasites were ever found.

The second part of this article discusses the cases in which the malaria itself produced surgical syndromes resembling those of appendicitis, cholecystitis, or gastric or duodenal ulcer. Certain elements of the true surgical picture (vomiting, constipation, facies peritoneal, and/or défense musculaire) were usually missing entirely, and most of the other cases would not have deceived a physician experienced in the vagaries of malaria. However,the author cites some dozen cases pronounced cholecystitis (2 cases) or appendicitis by the medical department and referred to surgery, in all of which but 2 the malarial nature of the dolor abdominalis was recognized satisfactorily and in time. Perhaps the case history disclosed malarial antecedence, or perhaps the abdominal wall was not sufficiently spastic for a défense musculaire, and out of proportion to the seeming amount of pain present; in any event, quinine satisfactorily cured all but 2 of these cases; only in 2 instances was laboratory help indispensable. The first instance was that of an artillerist, who had been in Sardinia for 3 years. This patient had sudden violent attacks of abdominal pain, localizing to the right iliac fossa, which were accompanied by fever (39°C. or thereabouts) with chills, vomiting, retention of feces and, partially, of gas, and some display of a neurotic disposition (weeping). Physical examination the following day disclosed "facies aniosa," a temperature of 39°C., rhythmic, thready pulse of 120, and a dry tongue; the abdomen was uniformly spastic, retracted, almost still (borborygmi), and presented diffuse cutaneous hyperesthesia. However, the abdominal spasm was not a true défense musculaire, as it was more or less equal in intensity on the two sides and could be largely influenced by distracting the patient's attention; also the appearance of the fever had been too brusque. In addition, the patient did not look sick enough for the presence of a phlogistic process. Blood examination disclosed the plasmodium praecox in great quantity. Quinine did not control the fever until the second day and even then the other symptoms persisted, some abdominal pain remaining for many days.

The second patient was an aviator, first class, who after 2 years in Sardinia suddenly developed intracostal pain, irradiating posteriorly, and fever of 39.2°C. Quinine injections on this same day were unsuccessful and the patient was referred to surgery under the diagnosis of acute cholecystitis. However, the impression was rather that of an atopic, subhepatic appendicitis, and the author was invited to examine the patient. The abdomen was found to be tensely spastic throughout and painful to palpation; the temperature was 39°C with some morning remission; the tongue was dry; in the gall bladder region the pain was more intense and there was some muscular defense at this point: neither the liver nor spleen was palpable. The topography and season suggested malaria, even though no parasites were determinable at blood examination: however, there were only 4,000 white cells, with 10 per cent monocytes and a few hemohistioblastocytes. Quinine therapy was again instituted and after 3 days the fever and pains had entirely disappeared. Here again the relatively good general condition of the patient throughout argued against a septic inflammatory process.

The author seems not to have encountered the phlogistic, even necrotic, processes at times, ascribed by other authors to malaria itself, such as the strumitis suppurata of malarial origin of Ceballos and Gomez, malarial peritonitis, Demjanow's appendicitis of malaria, Caruso's appendicitis of necrotic and gangrenous type, or the perivisceritis parassitaria of Pepere and of Donati, and he leaves open the question as to their authentically malarial character. However, he does cite an instance of hemoptysis in which operation did not reveal the origin of the bleeding, and which he therefore ascribed etiologically to the malarial parasite. He passed over such causes as turgor, small vascular thrombosis, and the production of punctate hemorrhages, capable of producing fatty degeneration, to the theory of so-called neurotropism of the malarial virus, wherein degenerative processes in the vegetative system give rise to vasomotor disturbances, a true angioneurosis. This theory was strengthened by the author's observation of a malarial (plasmodium praecox) asphyxia and paraesthesia pallida bilateralis of the feet which cleared up on a regimen of quinine, antispasmodics (atropin), and hot applications.

Among the involvements of the nervous system have also been those resembling an ascending polyneuritis, even involvements of the cord such as monoplegias with loss of reflexes and amyotrophias; one of the author's patients, apparently as a sequela of malaria, developed a rather persistent neuritis of the radial nerve with medicolegal implications.

The observation of the author, which seems to be unique in the literature, is that of a tertian malaria with concomitant tumefaction of the testicle and epididymis, without involvement of the endovaginal serosa or cord. The swelling and pain which was present disappeared gradually following cessation of the febrile attack, the detumescence being too rapid and complete for a pyogenic or other phlogistic process, and seemed due solely to the malarial infestation.

In conclusion, however, the author warns against a too ready acceptance of what might be a surgical condition in a malarial patient as an exclusive mala-

rial condition, and he cites 2 instances, one a ruptured appendix and the other an intestinal perforation in a patient with typhoid fever, in which operative therapy was deferred because of prejudice toward a malarial etiology of the abdominal pains. The patient with the ruptured appendix recovered later following operation, while the patient with typhoid fever did not. JOHN W. BRENNAN, M.D.

Waaler, E.: A Chromaffin Tumor Simulating Graves' Disease. *Acta med. scand.*, 1945, 123: 1.

Tumors arising from chromaffin tissue are very rare. About 100 cases have been described in the literature. Eighty of them had their source in the suprarenal glands, while the remainder arose from the paraganglia. Eighteen cases of extrasuprarenal chromaffin tumors have been reported in the literature. In several cases the tumors have given rise to characteristic clinical manifestations, the patients being subject to attacks of headache, a sense of pressure in the epigastrium, palpitation of the heart, excessive sweating, coldness and pallor of the limbs, and a high blood pressure. In the intervals between attacks the blood pressure would be normal and the patient would feel well. Belt and Powell have given this group of symptoms the title of "the suprarenal sympathetic syndrome." The true nature of the disease has often been overlooked in these cases.

An account of a misinterpreted case with pheochromocytoma originating in the right celiac ganglion is presented. A man, age 49, had been well until 3½ years ago when he developed a disease characterized by palpitation of the heart, excessive sweating, and nervousness which required hospital care on several occasions. During his first hospital stay the basal metabolism was 143 per cent, the pulse 80, and the blood pressure 176/112; there was enlargement of the heart, and albumin in the urine, and the latter contained erythrocytes and hyaline and granular casts. During his stay in the hospital the blood pressure was 190/112, 185/112, 170/120, and 116/114, and the basal metabolism ranged from 156 to 120 per cent. A diagnosis of Graves' disease and nephritis was made, and following preoperative therapy a thyroidectomy was done. The surgeon was in doubt as to the diagnosis at the time of the operation and his histological examination of the excised gland showed no changes characteristic of Graves' disease.

The attacks of palpitation of the heart and excessive sweating returned. During the second stay in the hospital the blood pressure varied between 230/149 and 155/90, but no relationship between it and the patient's symptoms was noted. The basal metabolism on four occasions was 140, 130, 116, and 108 per cent. The diagnosis was still considered thyrotoxicosis with hypertonia.

Upon his third stay he became worse and death occurred with signs of a subarachnoid hemorrhage. Postmortem examination revealed the pheochromocytoma in the right celiac ganglion, a brain hemorrhage, arteriosclerosis and arteriolar sclerosis, and enlargement of the heart. Analysis showed that the tumor contained less adrenalin than the tumors in several other cases investigated by the much more exact biological examination.

It is of special interest in this case that it was interpreted as one of Graves' disease. The diagnostic mistake is of interest for two reasons. In the first place, Graves' disease was suspected in some of the cases of chromaffin tumor published earlier. Furthermore, Belt and Powell drew attention in 1934 to the similarity of the syndrome of certain cases recently described as "nongoiterous hyperthyroidism" to the "suprarenal sympathetic syndrome." In the second place, it is interesting that the basal metabolism was increased in this case, not only because such an increase was misleading to the diagnosis, but also because it provided matter for thought concerning the cause for such an increase. According to Cohen in 1937, adrenalin increases the metabolism by stimulating the action of the sympathetic system. It has been found that patients with chromaffin tumors are sympathicotonic, and it is natural to assume that in these cases an increase of the basal metabolism depends on an increased production of adrenalin. Hitherto the manifestations observed of chromaffin tumors have included a rise of the blood pressure, tachycardia, excessive sweating, coldness of the limbs, glycosuria, and hyperglycemia. To these manifestations one may add an increase of the basal metabolism which will also be found. JOHN E. KARABIN, M.D.

CORRECTION

Attention is called to the abstract on page 442 of the May, 1946, issue of the International Abstract of Surgery. The heading of this abstract is incorrect and should read:

McCarthy, M. D., Lewis, J. R., and Conver, J.: A Standardized Back Burn Procedure for the White Rat Suitable for the Study of the Effects of Therapeutic and Toxic Agents on Long Term Survival. *J. Lab. Clin. M.*, 1945, 30: 1027.